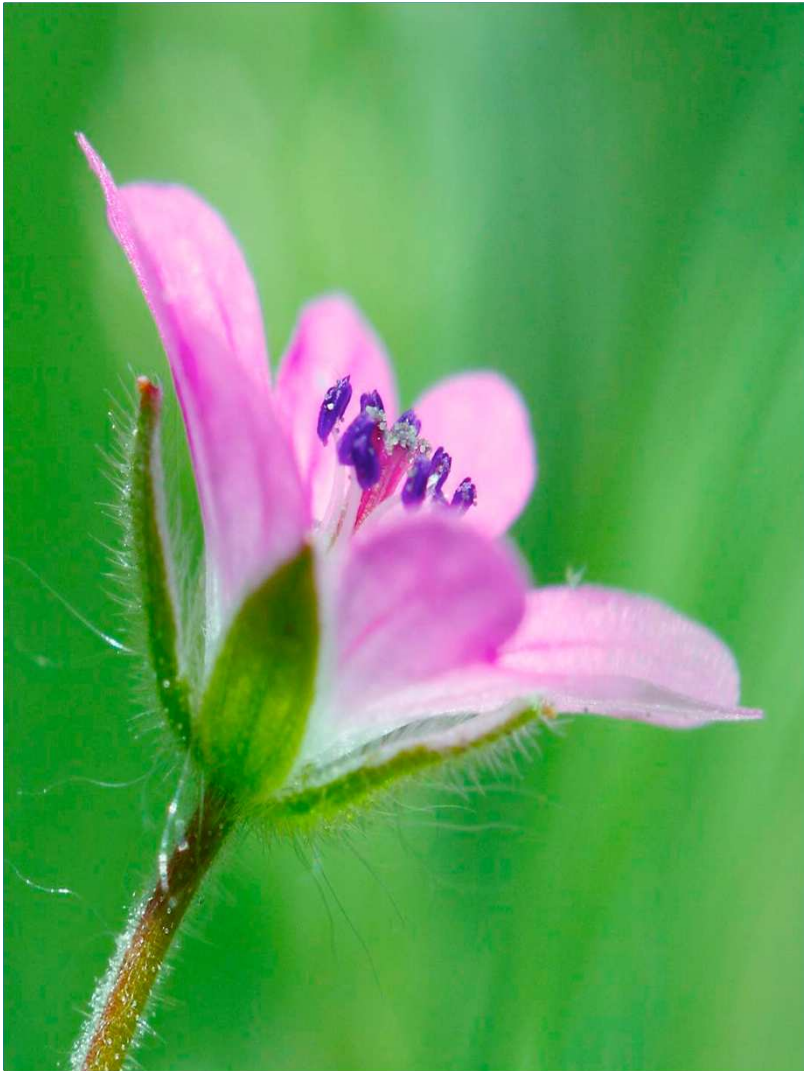


NASA – NOVEMBER 18, 2011

TPS TECHNOLOGIES SA

Thermal Desorption





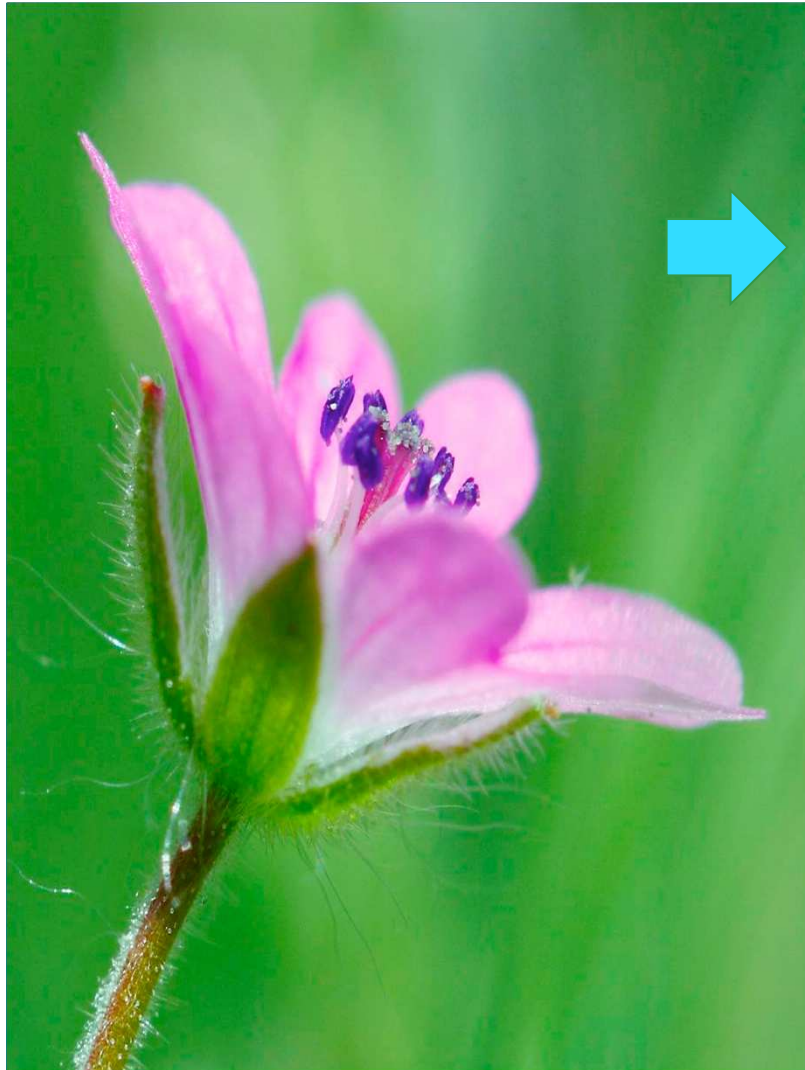
Content

TPS Tech – Who are we?

Thermal Desorption– 20 years evolution

NSR City©

NSR Industry©



Content

TPS Tech – Who are we?

Thermal Desorption- 20 years evolution

NSR City©

NSR Industry©

TPS – Company

+ Technology and services provider Thermal Desorption

- + 20 years experience
- > 8 millions tons treated by thermal desorption
- World patents developed - Innovation!

+ Competent team

- 12 employees - 1 laboratory
- Direct operator or subcontractor of soil remediation projects

+ International partners

Off Site Thermal Desorption



United States Patent [19]
Wood



US005199354A

[11] **Patent Number:** **5,199,354**
[45] **Date of Patent:** **Apr. 6, 1993**

[54] **MOBILE SOIL REMEDIATION SYSTEM**

[75] **Inventor:** **Kenneth L. Wood, Apopka, Fla.**

[73] **Assignee:** **TPS Technologies, Inc., Apopka, Fla.**

[21] **Appl. No.:** **840,640**

[22] **Filed:** **Feb. 21, 1992**

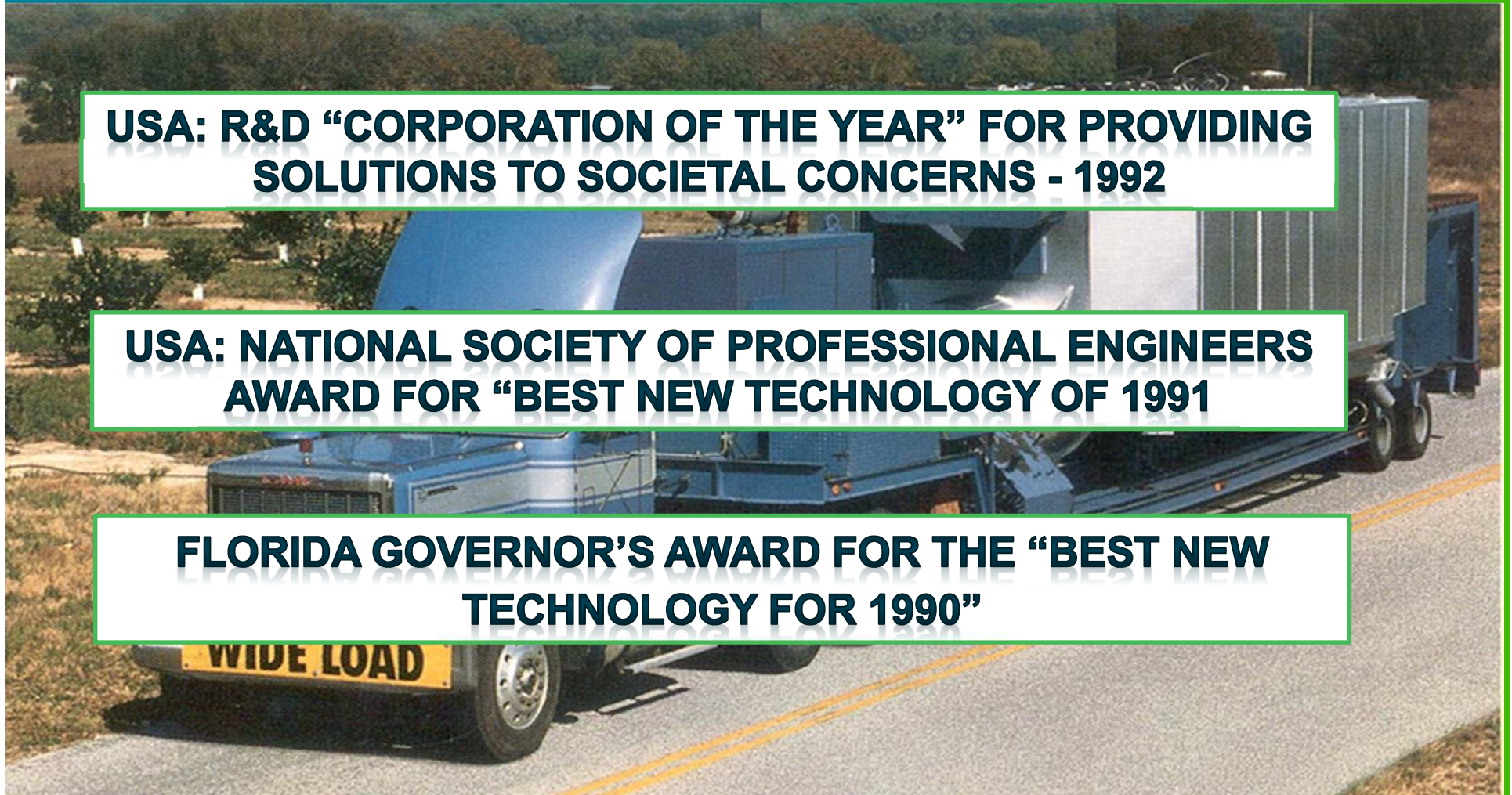
Related U.S. Application Data

4,376,373	3/1983	Weber et al.	60/648
4,627,365	12/1986	Tseng	110/240
4,667,609	5/1987	Hardison et al.	110/236
4,700,638	10/1987	Przewalski	110/346
4,730,564	3/1988	Abboud	110/246
4,738,206	4/1988	Noland	110/346
4,748,921	6/1988	Mendenhall	110/346
4,782,625	8/1988	Gerken et al. .	
4,864,942	9/1989	Fochtman et al.	110/226
4,951,417	8/1990	Gerken et al. .	

USA: R&D “CORPORATION OF THE YEAR” FOR PROVIDING SOLUTIONS TO SOCIETAL CONCERNS - 1992

USA: NATIONAL SOCIETY OF PROFESSIONAL ENGINEERS AWARD FOR “BEST NEW TECHNOLOGY OF 1991

FLORIDA GOVERNOR’S AWARD FOR THE “BEST NEW TECHNOLOGY FOR 1990”



Thermopile ©



ENVIRONMENTAL INNOVATION PRIZE – THE NETHERLANDS - 2011



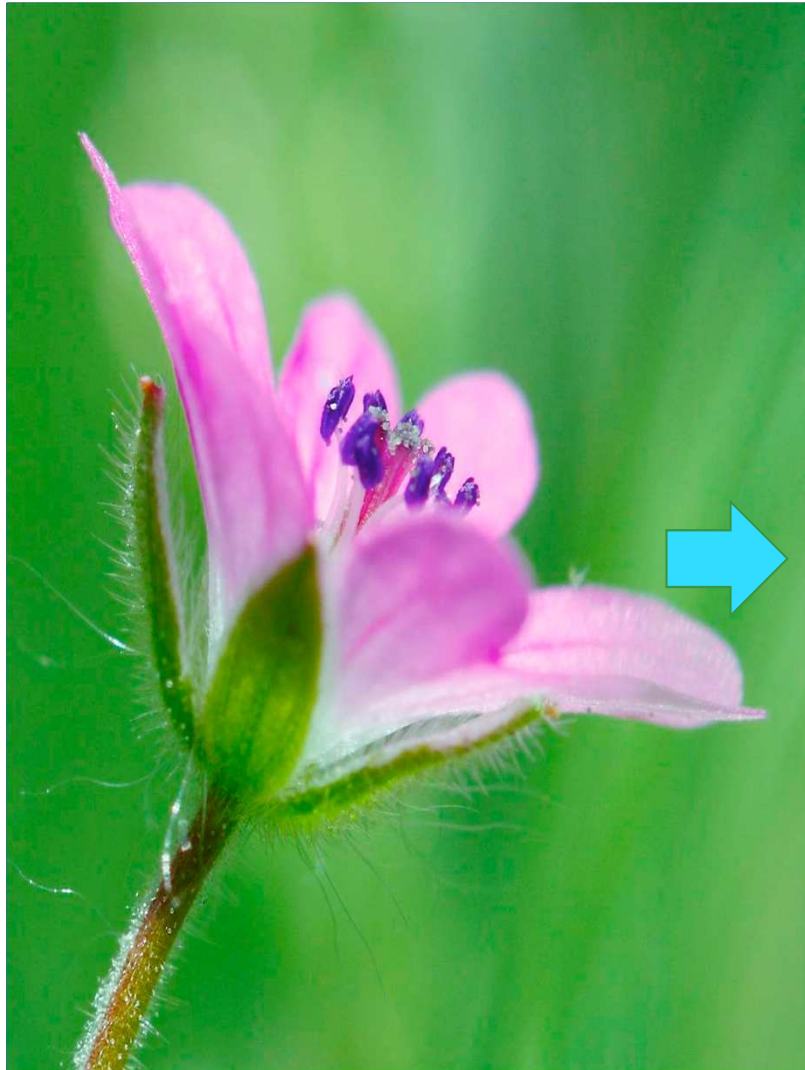
Our ambition...

Provide technological solutions for soil and groundwater contamination

- Restore the full *financial value* of contaminated land
- Reduce remediation costs
- Reduce environmental impact
- Reduce, or even eliminate *uncertainties* linked to remediation (costs, timing, results)
- Promote the reuse of polluted land (instead of agricultural land consumption)

Why thermal?

Manage the pollution: <i>Long term clean-up liabilities remain</i>	Eliminate pollution: <i>No more long-term clean-up liabilities</i>
<ul style="list-style-type: none"> Landfilling <ul style="list-style-type: none"> <i>Not really an option any more</i> 	<ul style="list-style-type: none"> Chemical treatment <ul style="list-style-type: none"> <i>Limited applicability</i> <i>Expensive</i>
<ul style="list-style-type: none"> Stabilisation <ul style="list-style-type: none"> <i>Sustainable?</i> 	<ul style="list-style-type: none"> Incineration <ul style="list-style-type: none"> <i>Residue</i> <i>Expensive</i>
<ul style="list-style-type: none"> Biological treatment <ul style="list-style-type: none"> <i>Reduces contamination to...??</i> 	<ul style="list-style-type: none"> Thermal <ul style="list-style-type: none"> <i>Re-usable soil</i> <i>Affordable</i>
<ul style="list-style-type: none"> soil washing <ul style="list-style-type: none"> <i>Reduces contamination to..?</i> 	



Content

TPS Tech – Who are we?

Thermal desorption- 20 years evolution

NSR City©

NSR industry©

From conventional → in-situ

- Reducing costs
- Reducing environmental impact
- increasing flexibility
- Increasing applications

2 phases:

1. Heating soil → clean soil
2. Treating polluted gas

Emissions control

Post-combustion
of polluted gases

Baghouse, etc.

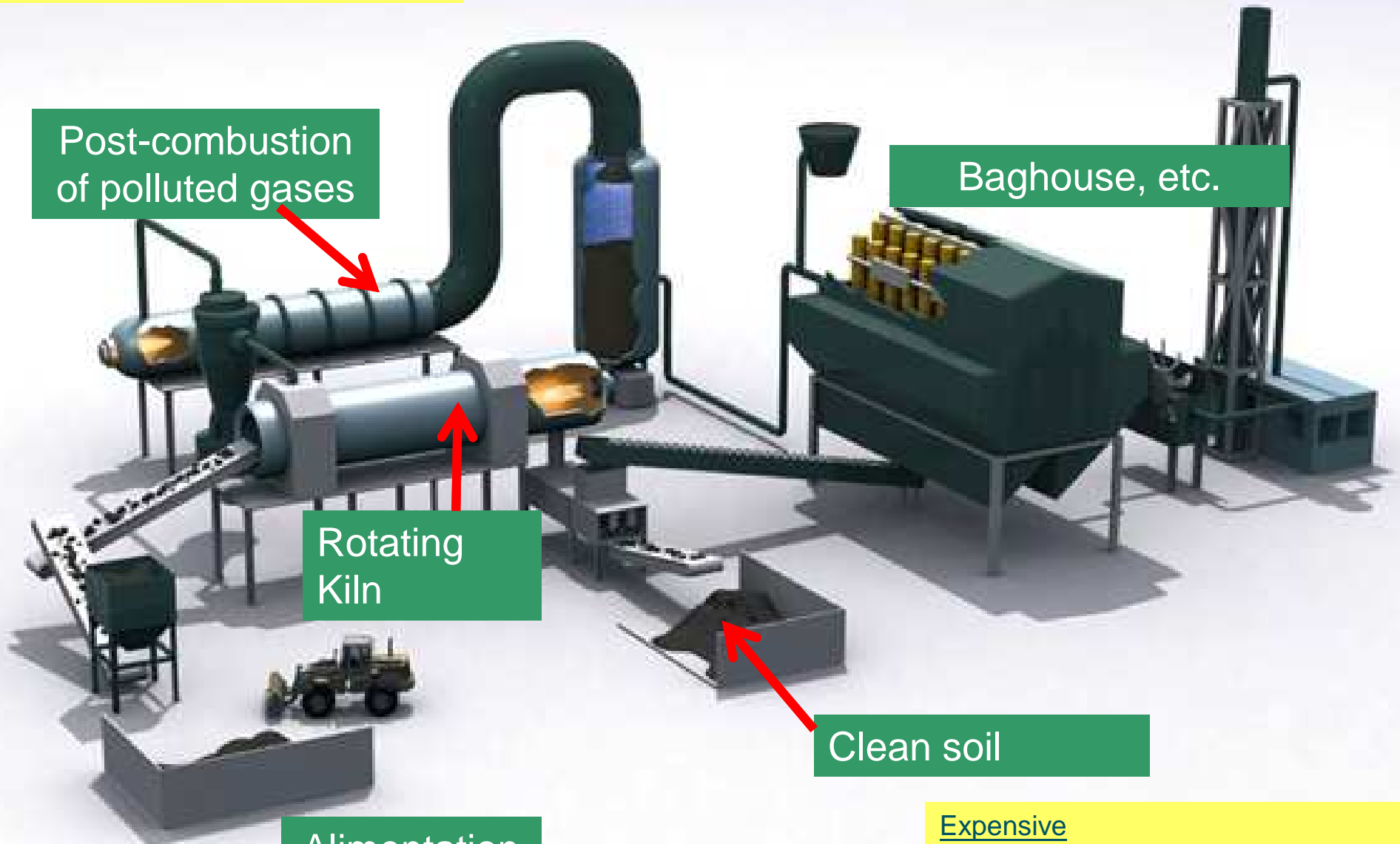
Rotating
Kiln

Clean soil

Alimentation

Expensive

- Energy inefficiency
- Complex gas treatment
- Maintenance



In Situ Thermal techniques

- + Heat transfer to the soil causes the evaporation of pollutants
- + Various methods for heat transfer:
 - *Hot air and/or steam injection*
 - *Direct electrical power (six phase heating)*
 - *Conduction*
- + The volatilized pollutants are extracted and treated (oxidized and/or adsorbed) at the surface

Why conduction?

Hot air and/or steam injection:

- *Highly dependent on soil type (permeability)*
- *Very difficult for clay/ silty soils*

Direct electricity:

- *Dependent on soil (electrical conductivity)*
- *Vagabond currents*

Conduction:

- *Applicable in each type of soil*

Heat transport– types of soils

Thermal conductivity

$$\frac{\text{clay}}{\text{soil (sand)}} = \frac{1.3}{0.52} = \mathbf{2.5}$$

Fluid permeability

$$\frac{\text{soil (sand)}}{\text{clay}} = \frac{0.1}{10^{-9}} = \mathbf{100,000,000}$$

NSR (New Soil Remediation)

+ Phase 1: Heat the soil

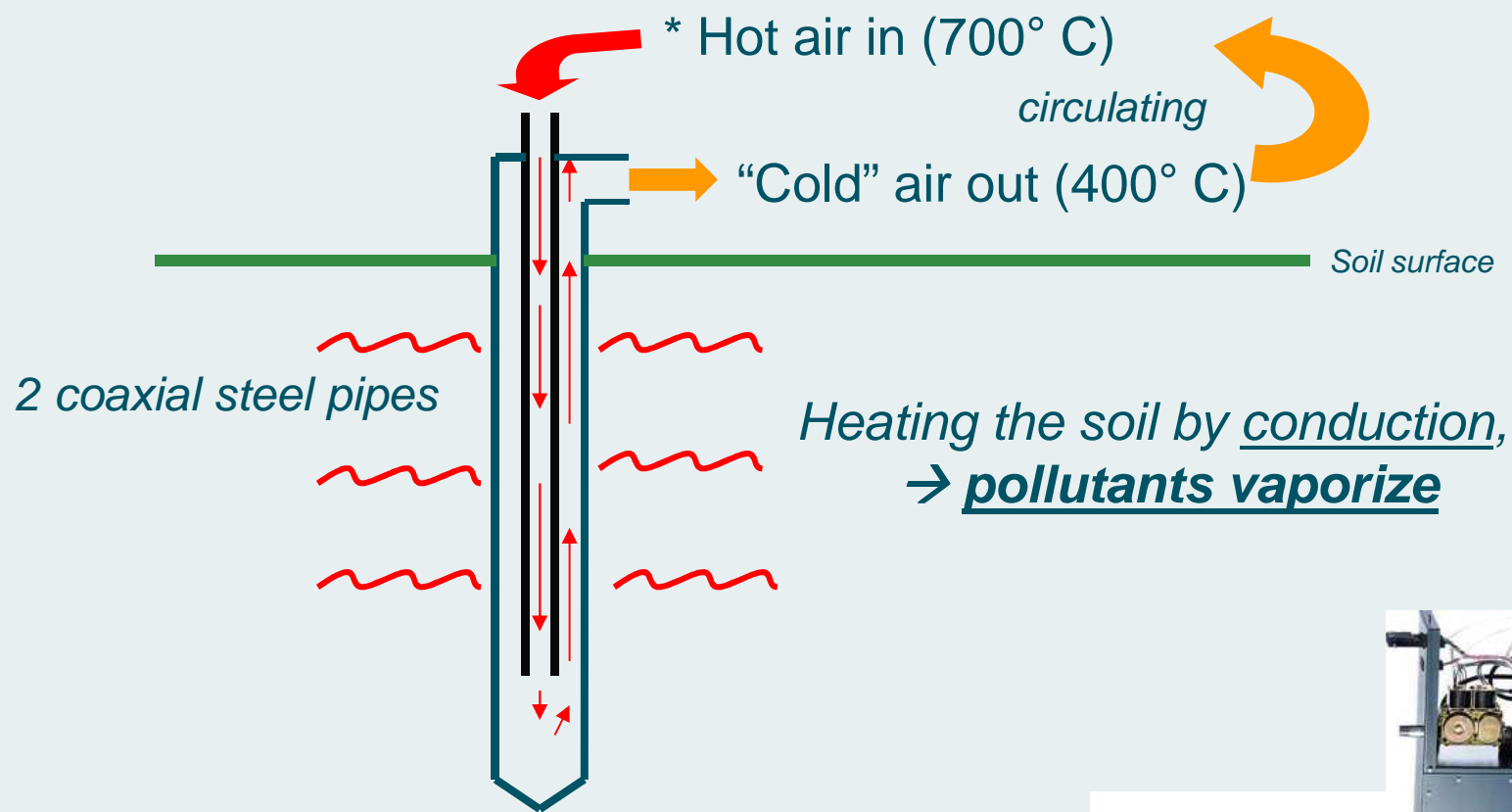
- *With in situ heating elements (horizontal, vertical, diagonal)*
- *By conduction*

+ Phase 2: Treat contaminated gas

- *Thermal oxidation*
- *If needed plus extra treatment*
- *Reuse as fuel*

Maximum reuse of heat produced

Phase 1: Heating the soil



* Burner unit



Heating tubes(co-axial)

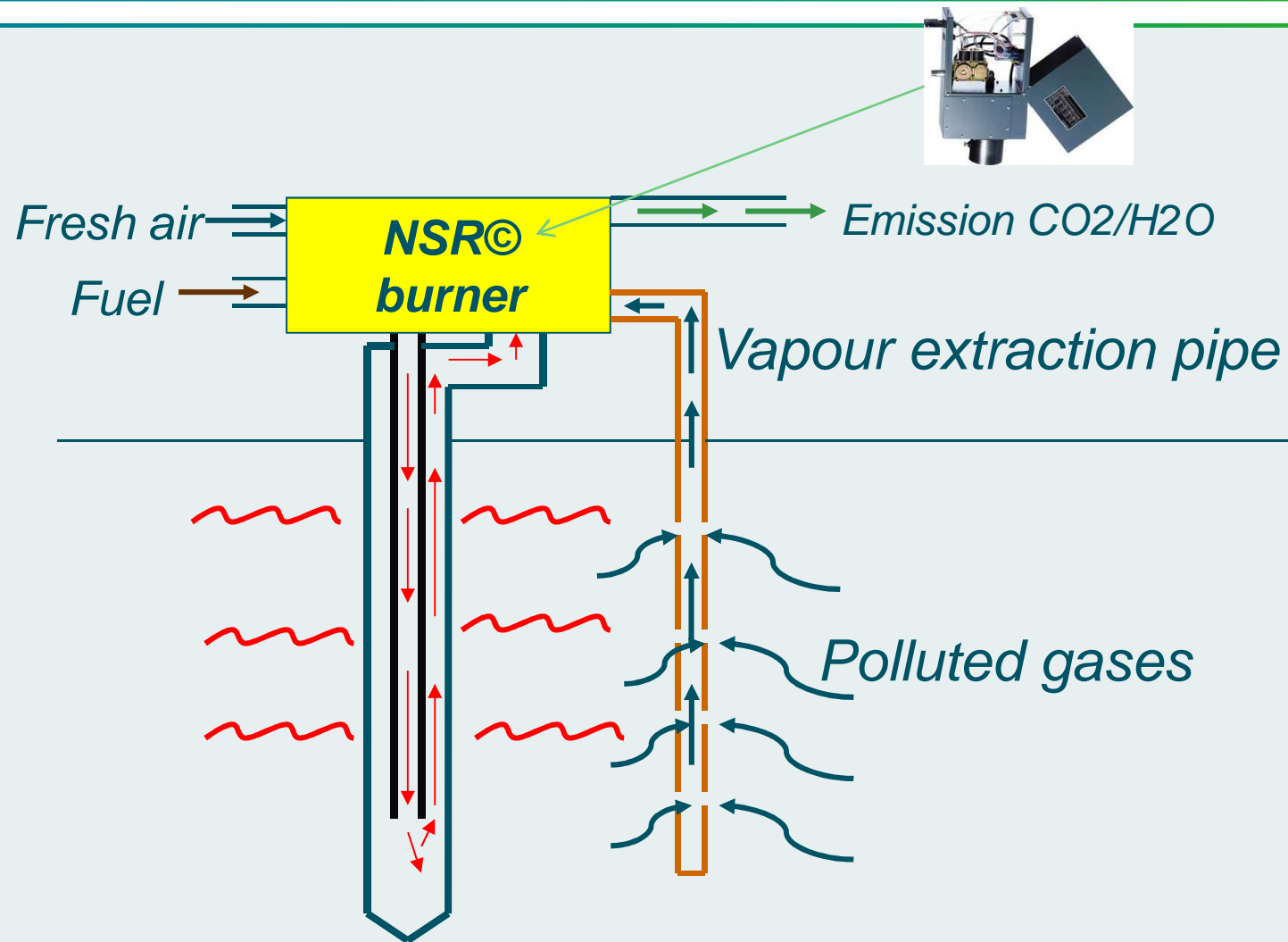


Outer tube

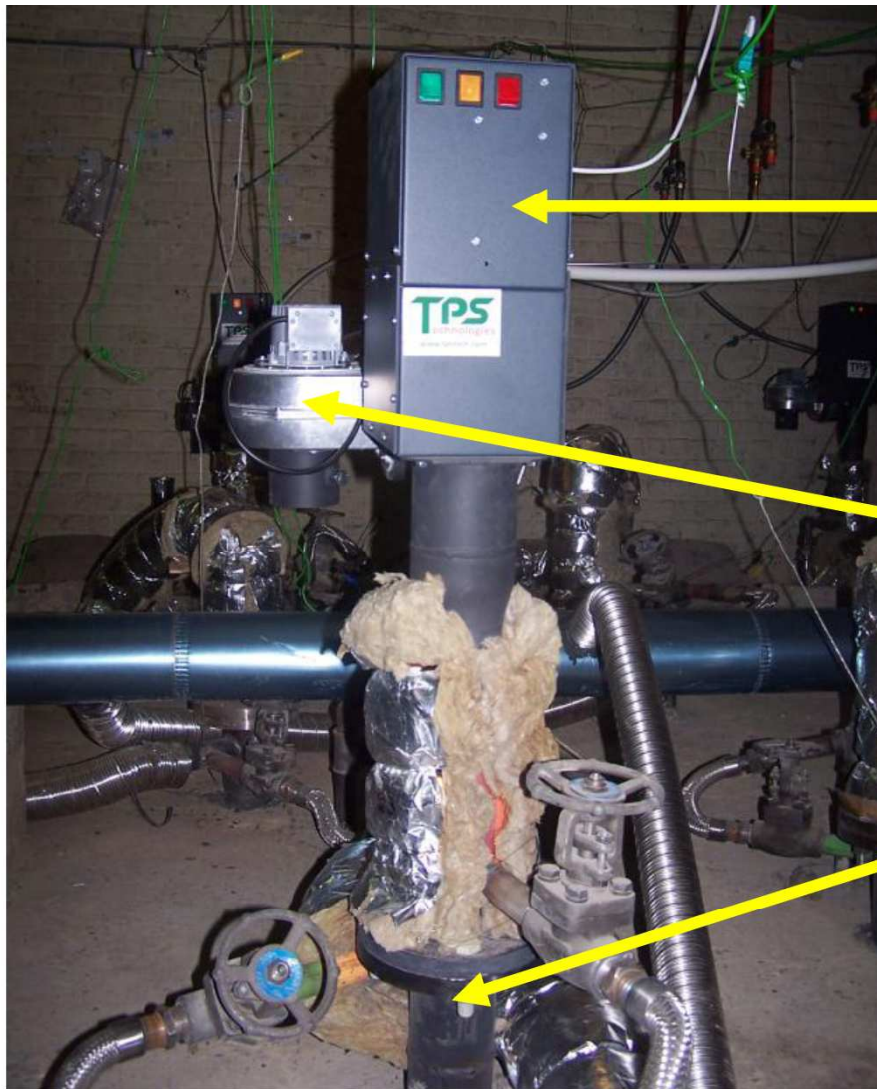
Inner tube



Phase 2: Gas treatment



Modern Thermal Desorption Unit

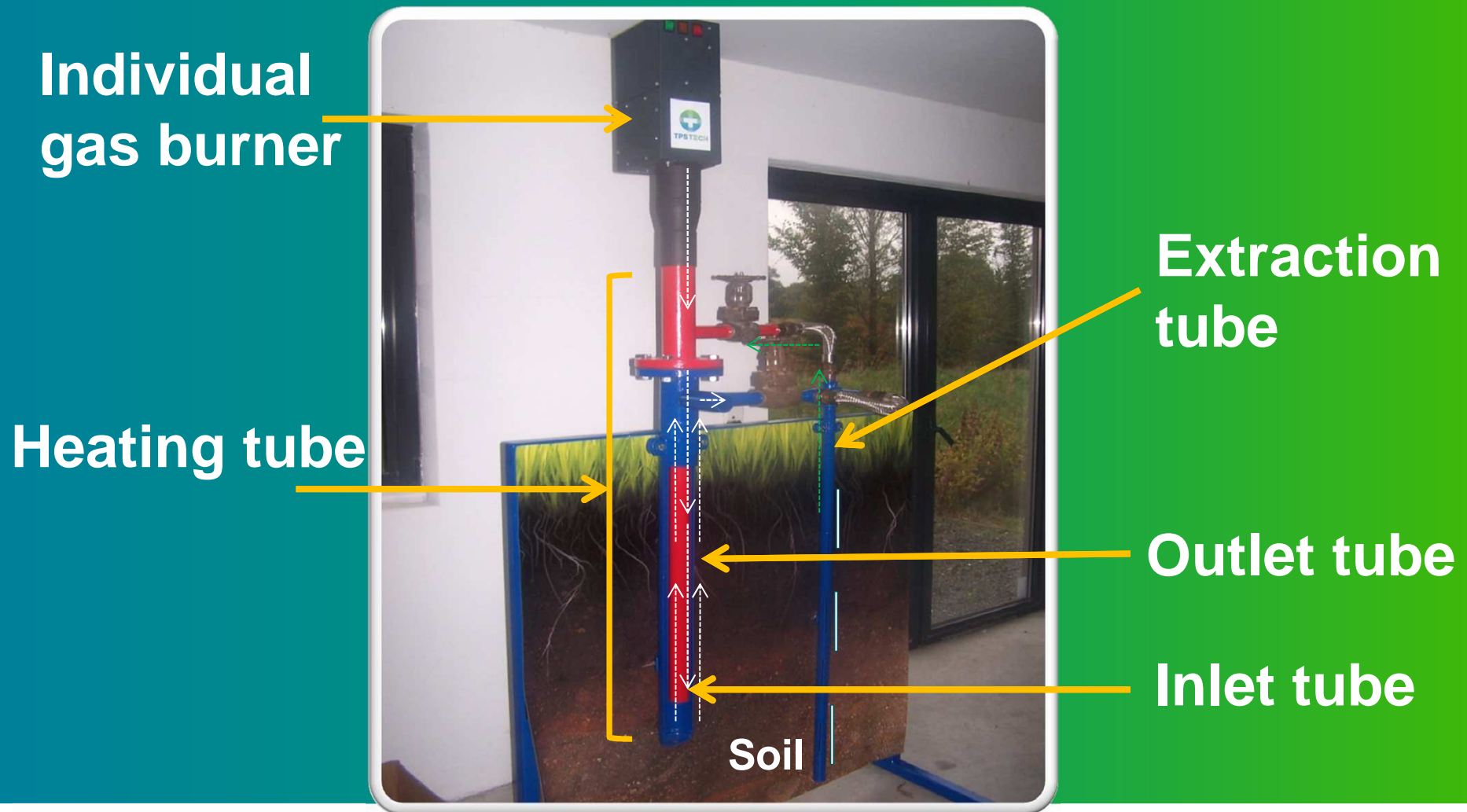


Burner

Ventilator

Soil Heating
element

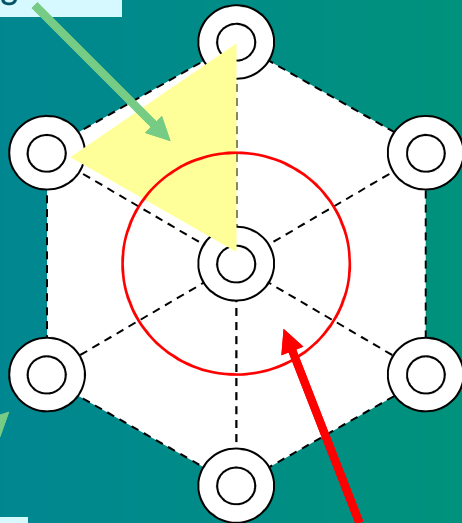
NSR – How does it work?



configuration

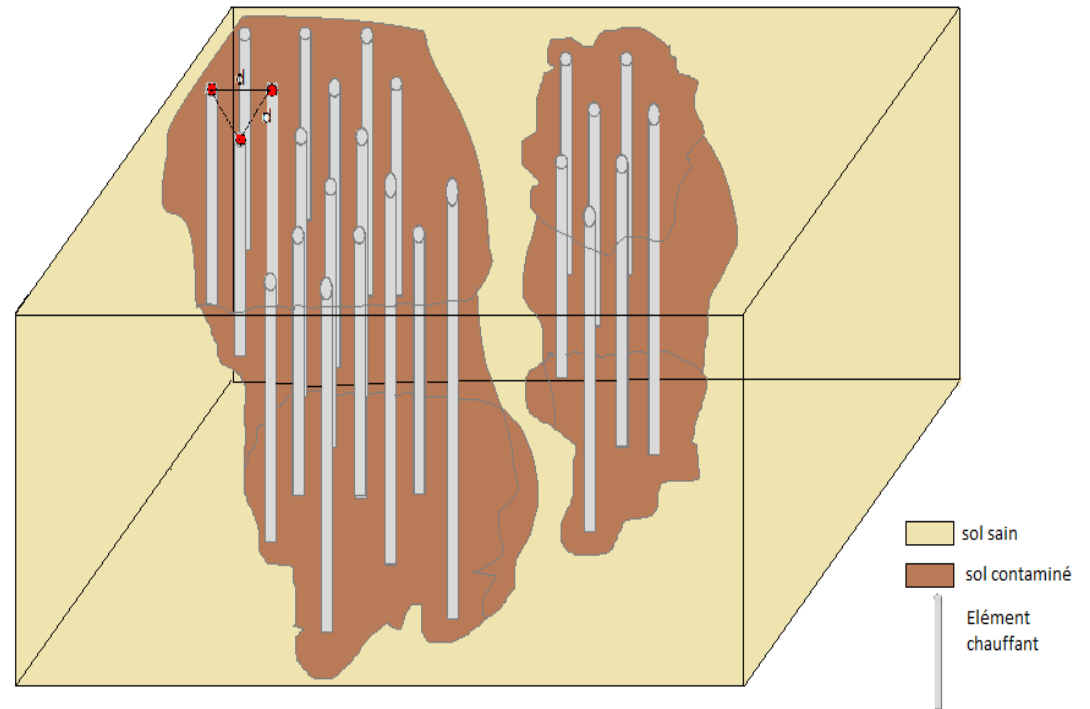
Cold point:

Centre of triangle

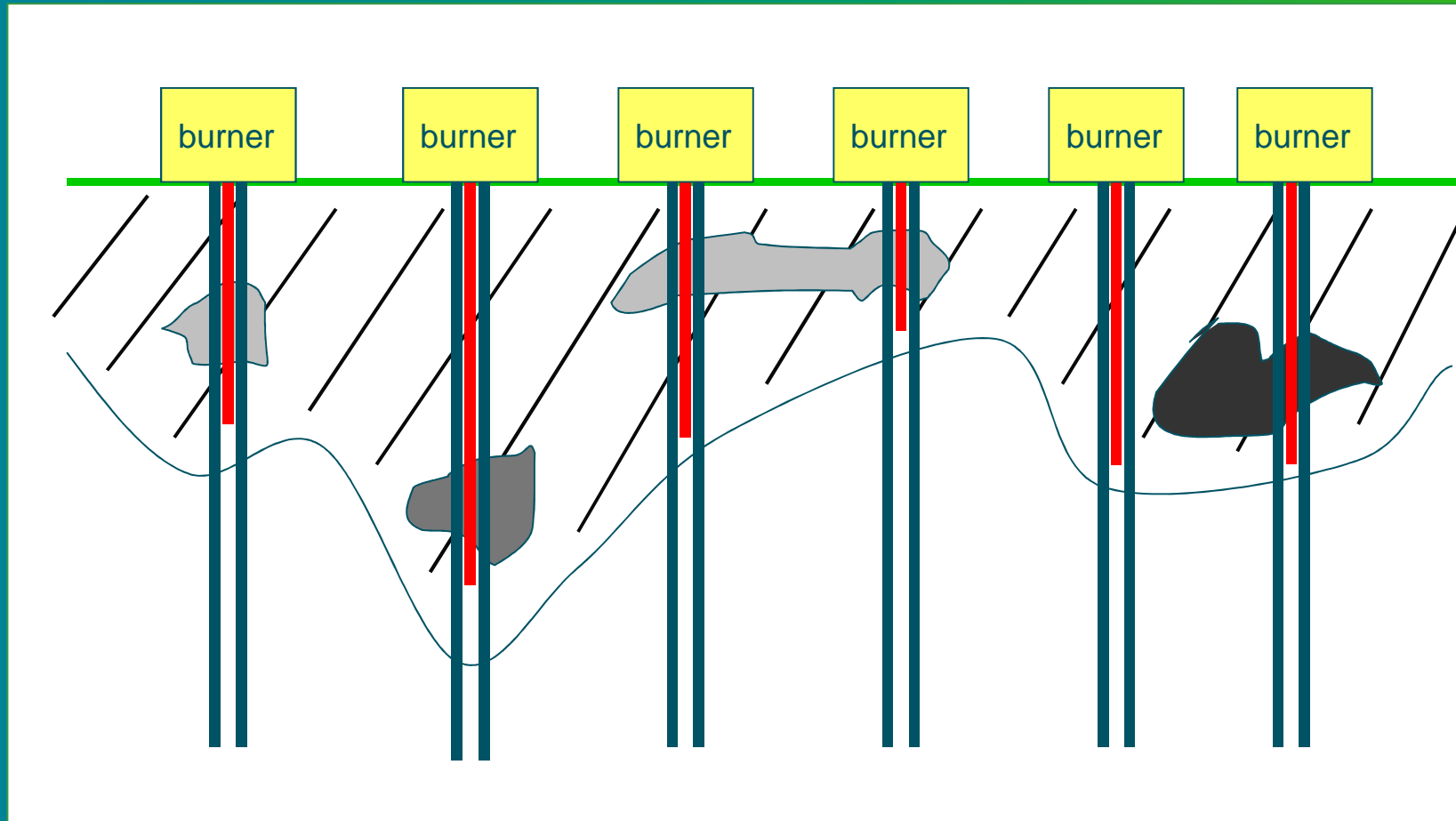


Tube

**Radius of
influence of the
tube**



Scalable and flexible



Why individual burners?

+ Low energy consumption

- 100 à 150 kWh/ton
- Energetical efficiency: 65 to 80%

+ Safety

- Totally closed
- Low power(40 KW)

+ Easy to move(15 à 20kg)

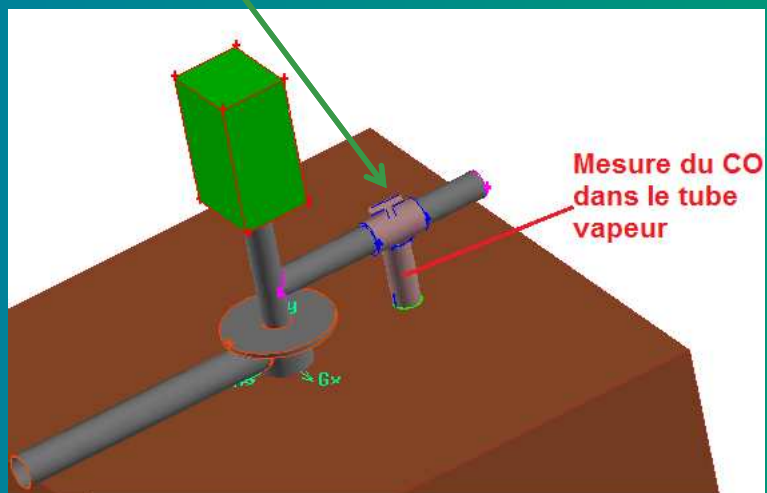
+ Maximal flexibility

- Length, number, orientation, timing

How do we know it is clean?

Indirect measurements (TPS)

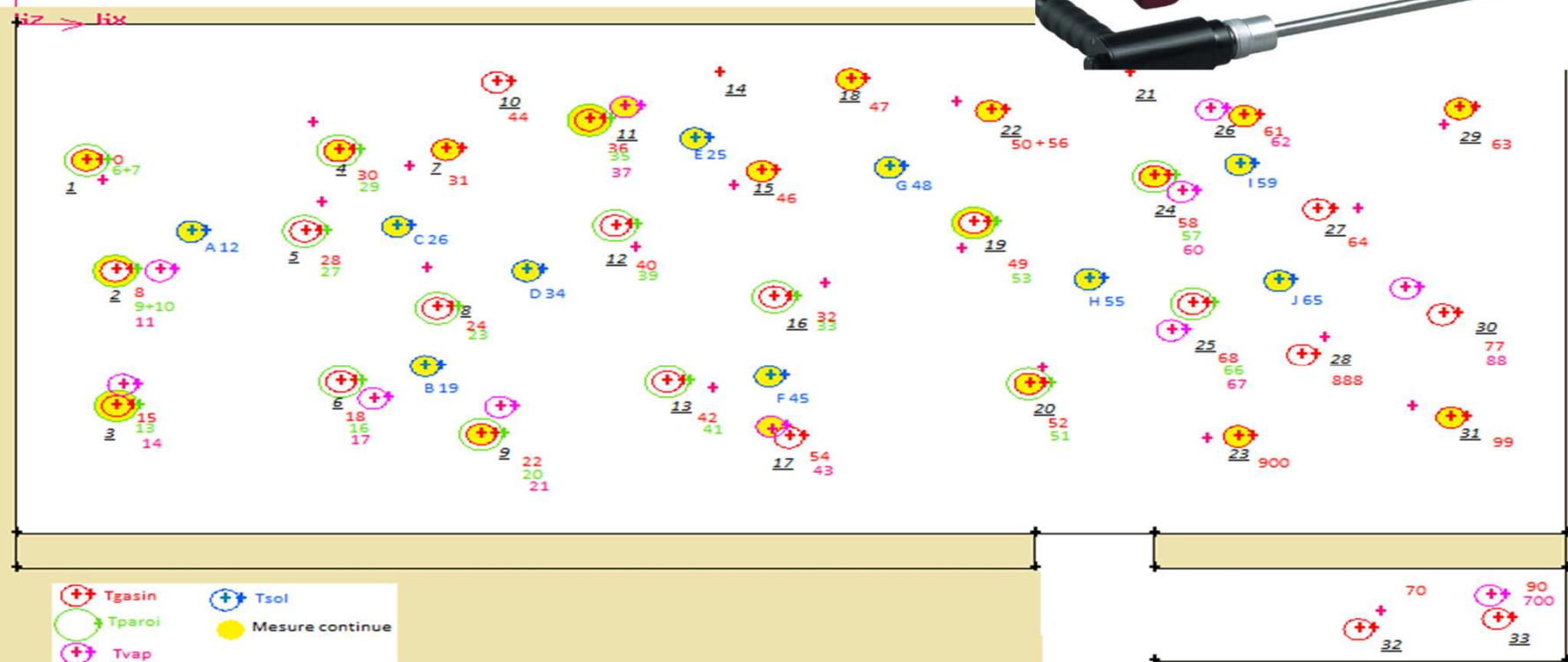
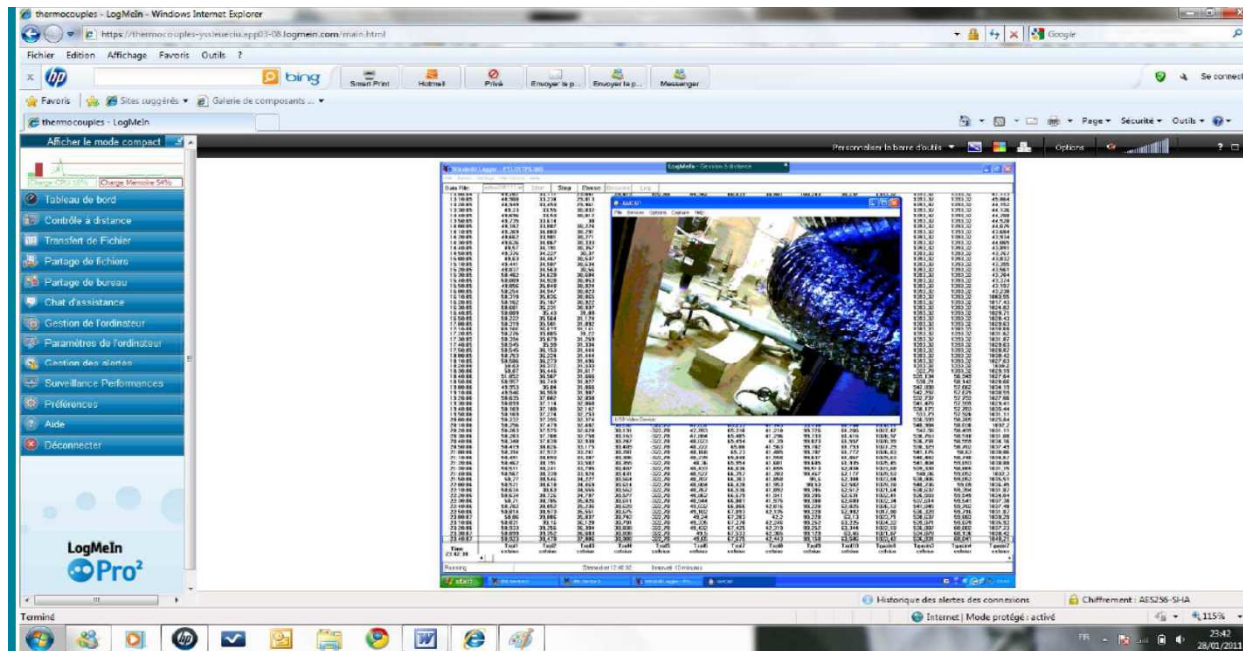
- temperature
- CO



Direct measurements (consultant)

- Drillings
- Soil sampling

Monitoring and control



Applications

- + Treatable pollutants:**

- *All except heavy metals*

- + Treatment of floating layers (NAPL)**

- + Groundwater treatment (in development)**

- + Important depth**

- >20 m if necessary

Treatable pollutants

Température d'ébullition de certains contaminants

HAP

Naphtalene	218 °C
Acenaphtylene	280 °C
Acenaphtalene	279 °C
Fluorene	295 °C
Phenantrene	340 °C
Antracene	342 °C
Fluoranthene	375 °C
Pyrene	393 °C
Benzo(a)Fluranthene	482 °C
Chryseen	488 °C
Benzo(b)Fluoranthene	480 °C
Benzo(k)Fluoranthene	480 °C
Benzo(a)pyrene	371 °C
Benzo(ghi) perylene	550 °C
Indeno(1,2,3-c,d)pyrene	530 °C

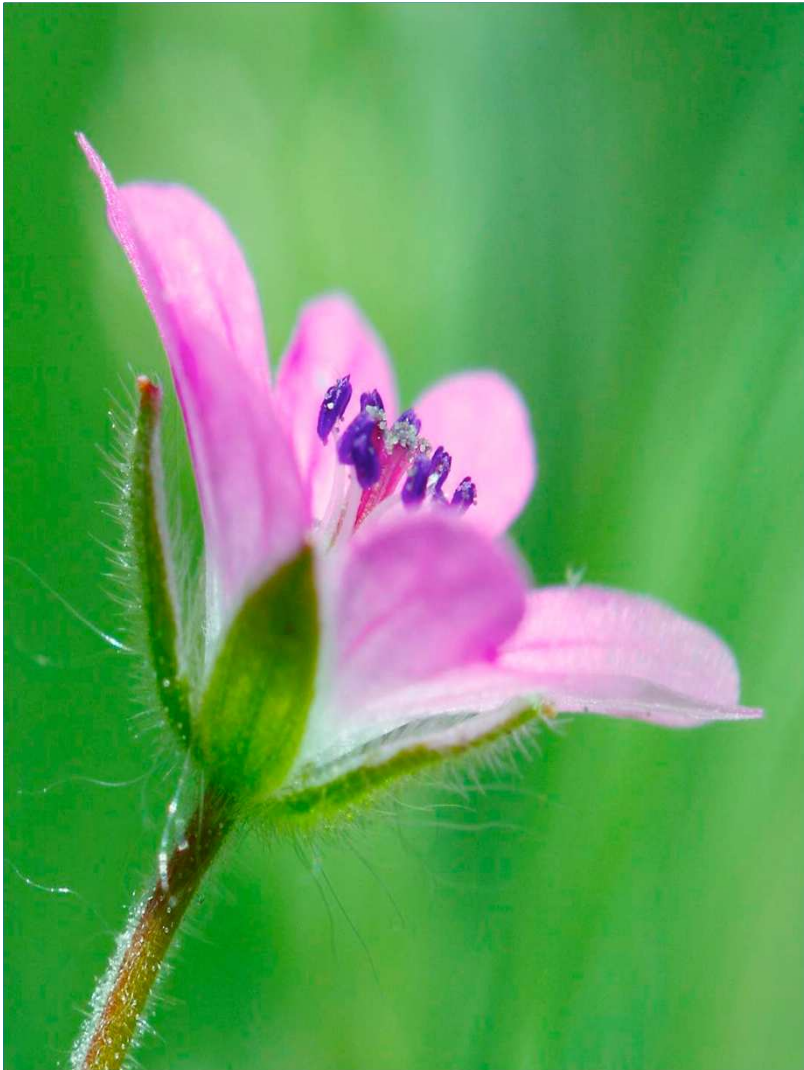
Hydrocarbures

Essence	221 °C
Diesel	343 °C
Fioul lourd	443 °C

Autres

PCB	<350 °C
Phenols	310 °C
TNT	300 °C
Cyanide	430 °C
Mercure	320 °C
Sulphure	414 °C
Solvants chlorés	60 °C

All organic compounds
with boiling point < 550 °C



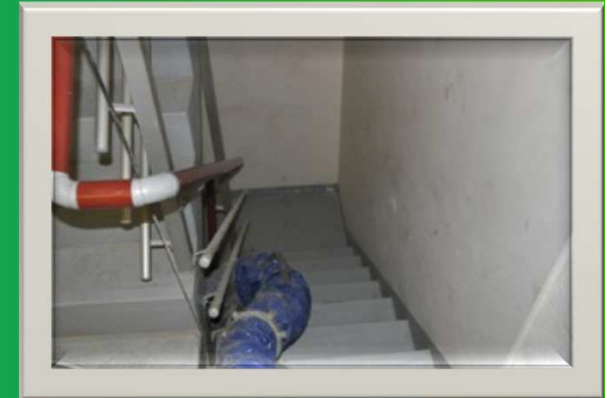
Pylos – Av Louise 1050 Brussels



Project Pylos – Situation

- + Former HQ of Bayer
- + Centre of Brussels
- + Pollution in cellar (level-3) oil (heating)
 - Concentration max 25.000 ppm
 - Depth: -7m below level -3
 - Very difficult access
- + Objective: < 300 ppm HCT (everywhere)
- + Consultant: ARCADIS

This is in situ and complicated....



Project Pylos – key dates

+ Contracted:	23/12/2010
+ Authorisation IBGE:	07/01/2011
+ Mobilisation:	10/01/2011
+ Tests:	20/01/2011
+ Start heating:	27/01/2011
+ Ready:	22/02/2011

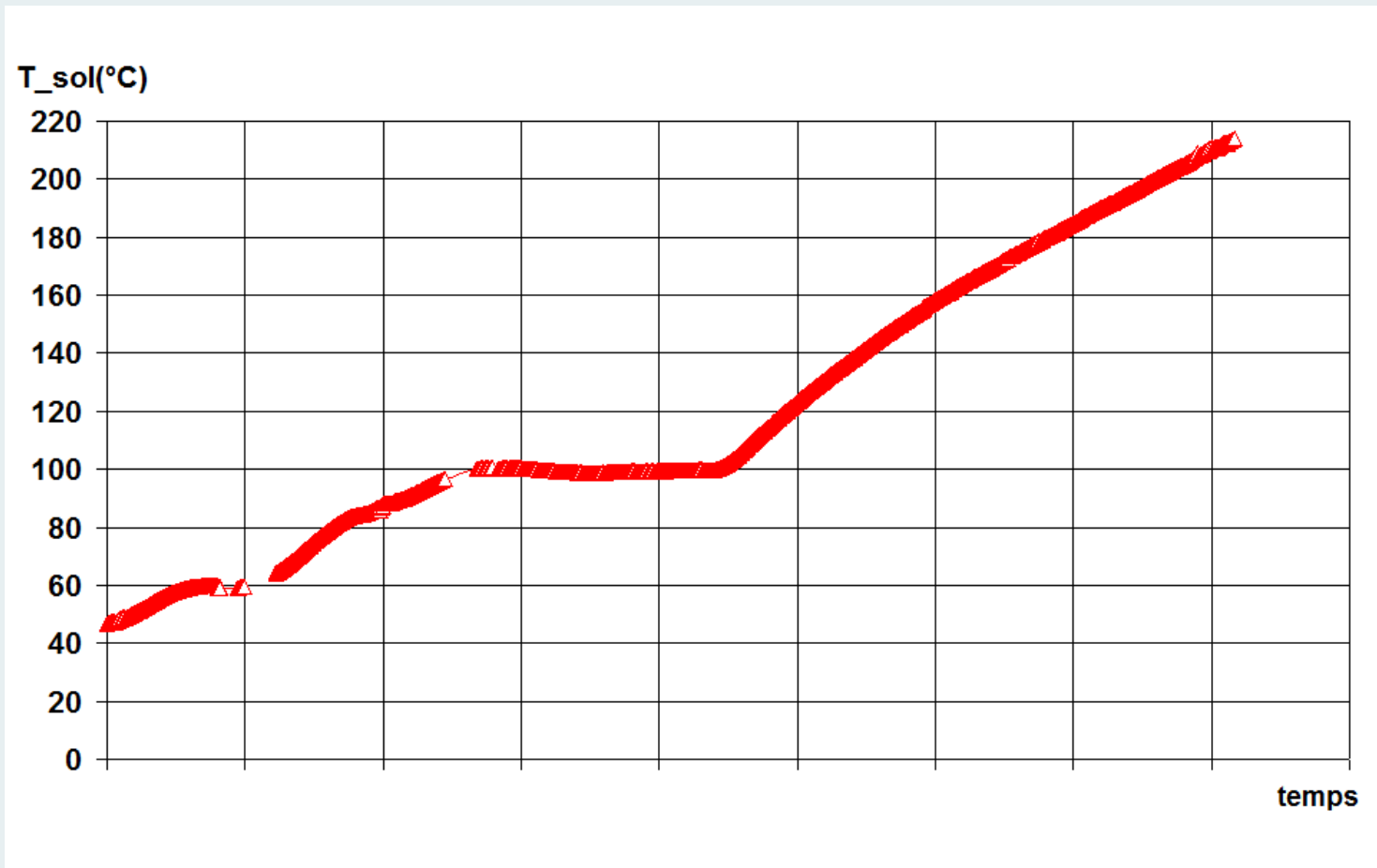
Project Pylos – installing..







Project Pylos – Temperature development



Results

+ Sampling ARCADIS:22/2 au 24/2

+ 6 Samples, at depths of 0,4 to 7,1 m

	0,5	1,5	2,3	3,5	4,5	7,1
Result (mg/kg)	< 36	100	150	<36	<50	<50
Target	300	300	300	300	300	300
	OK	OK	OK	OK	OK	OK

CLEAN...!!

Brussel,

Afdeling: Milieupolitie en Bodem
Onderafdeling: Bodems
Departement: Behandeling van verontreinigde bodems
Contactpersoon: Bernard Lemaire, ingenieur
Telefoon: (+32) 2 775 79 05
Fax: (+32) 2 775 75 05
E-mail: ble@ibgebim.be
Onze ref.: INSP/BLE/SOL.00447.2010
(te vermelden in elk volgend schrijven)
Datum van opstelling: 02/08/2011
Cc: houder(s) van zakelijke rechten, exploitant(en) van
risicoactiviteiten¹, gemeentecollege

Pylos Louise nv
Brugmannlaan 16
1060 Sint-Gillis
T.a.v. Dhr Johan Theunis

AANGETEKENDE BRIEF

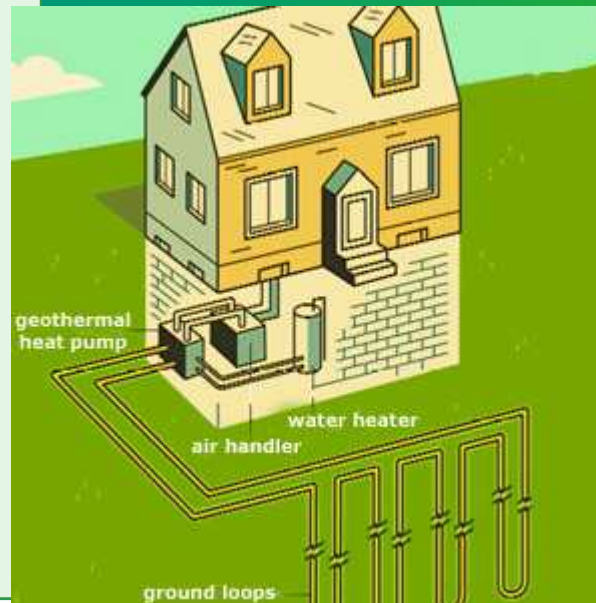
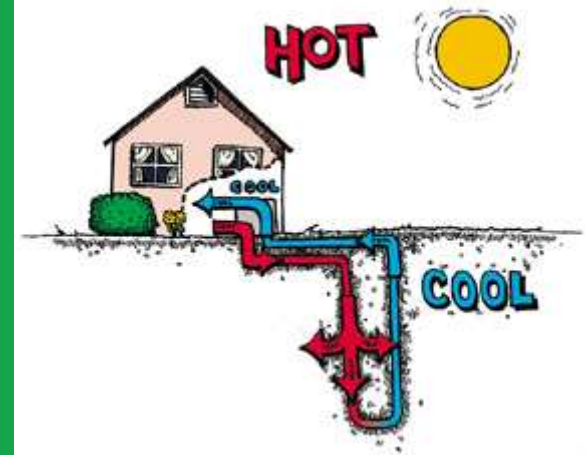
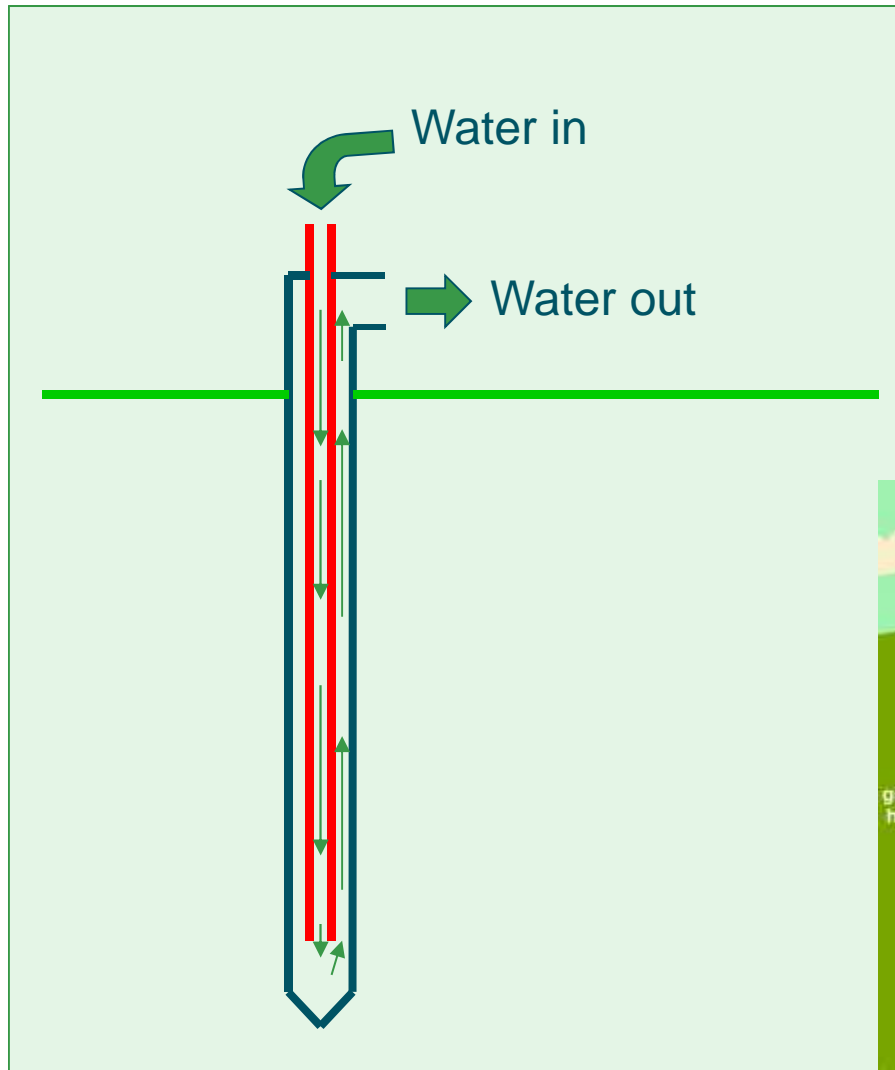
Betreft: Terrein gelegen Livornostraat 80 te 1050 Brussel – Saneringswerken
Kadastraal perceel : 21807_G_0089_Z_006_00

SLOTVERKLARING

OPNAME IN DE INVENTARIS VAN DE BODEMTOESTAND

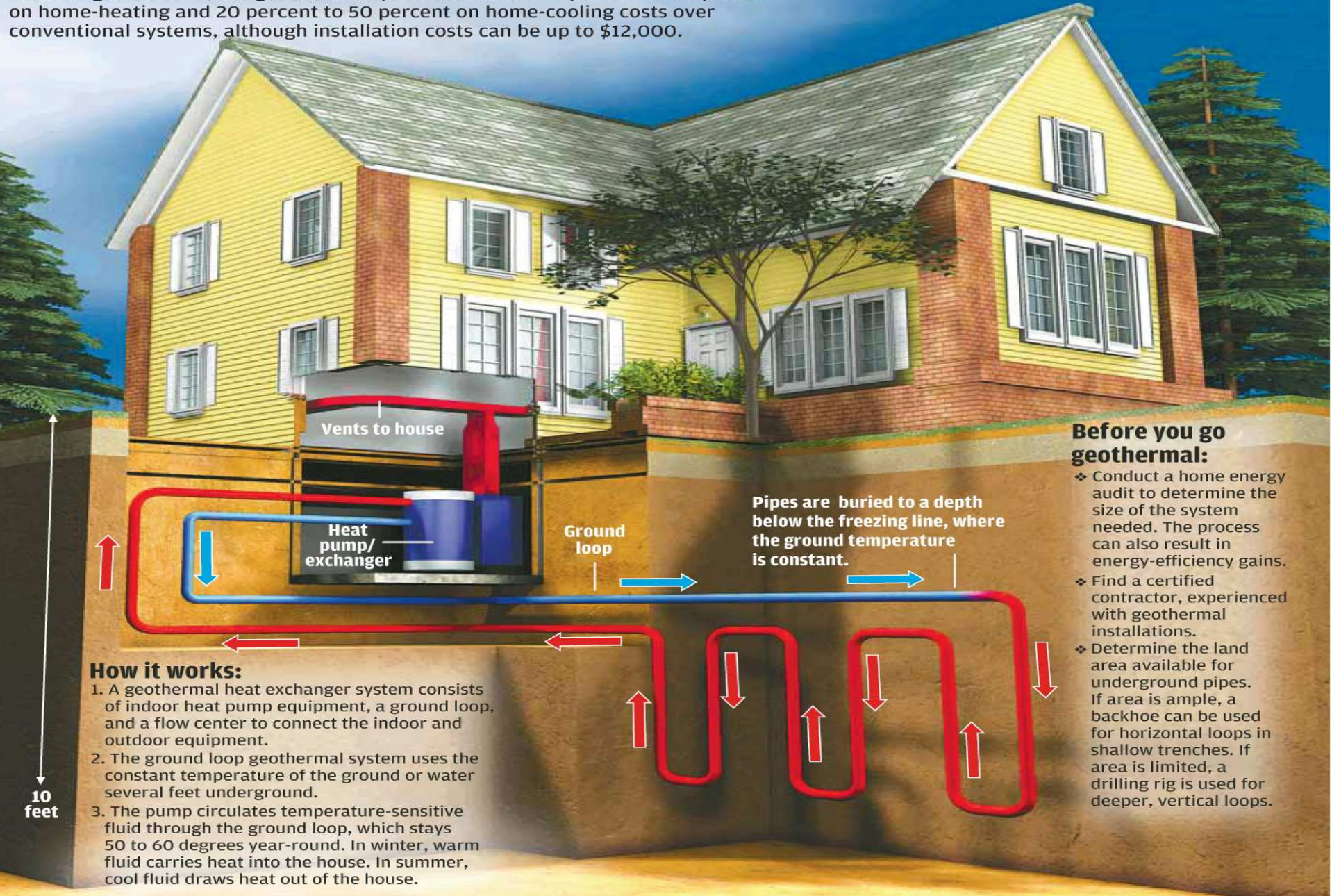
Gezien er geen enkele overschrijding van de saneringsnormen werd vastgesteld, noch in de bodem, noch in het grondwater, en er, voor zover wij weten, op dit ogenblik geen risicoactiviteiten op dit perceel plaatsvinden, heeft het BIM beslist om het perceel 21807_G_0089_Z_006_00 op te nemen in de inventaris van de bodemtoestand in categorie 1.

Re-use of NSR installation: cold/heat storage



Tapping the underground

Geothermal heat pumps use stable ground temperatures for home heating and cooling. According to the EPA, the geothermal systems can save 40 percent to 70 percent on home-heating and 20 percent to 50 percent on home-cooling costs over conventional systems, although installation costs can be up to \$12,000.



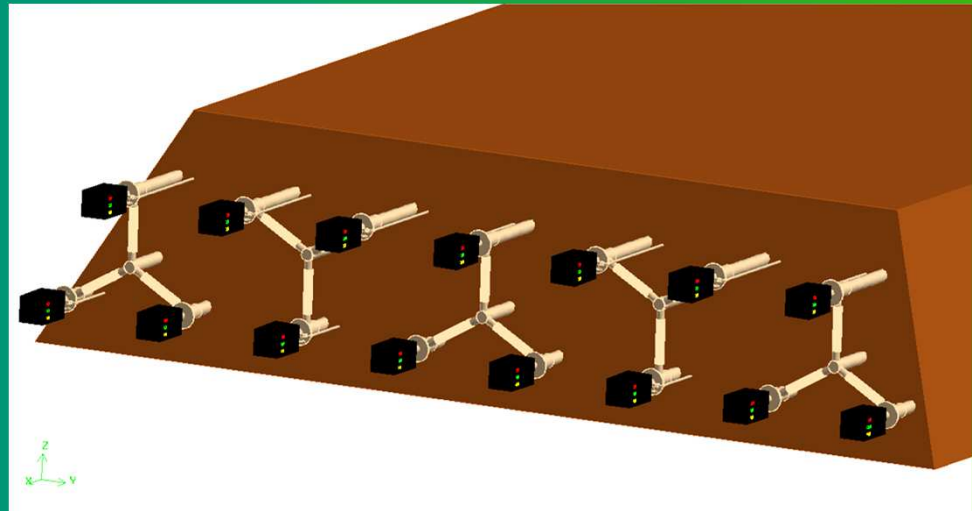
NSR City© - summary

- + In situ treatment (NO EXCAVATION)**
- + No trucks, no noise, no smell**
- + Fast and final**
- + Guaranteed fixed price, timing and results**
- + All contaminants except heavy metals**

NSR Industry©: on site (excavated soil)



“Lasagne” concept



Case on site project Normandie

+ 650 m³

+ PAK's (creosote) and mineral oil

+ Concentrations up to 50.000 mg/kg dm

+ Target: PAK < 50 mg/kg; Oil < 300 mg/kg



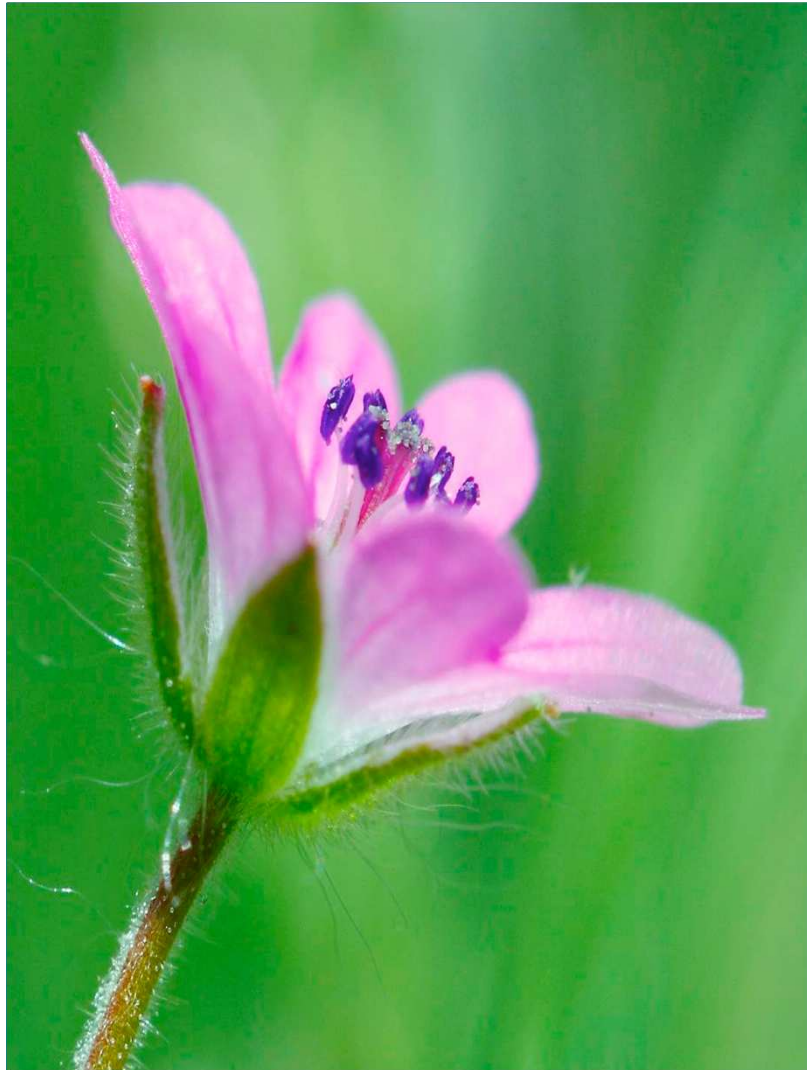




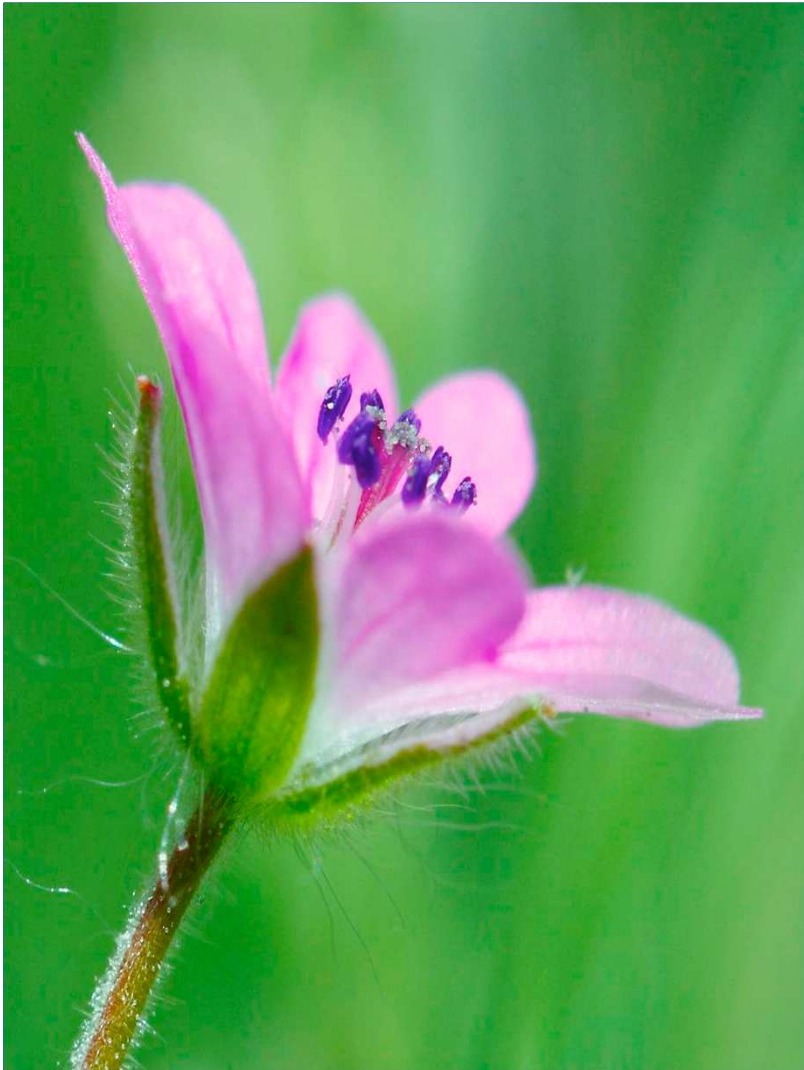


Results

- + Total project: 2 months**
- + Heating 5 weeks**
- + All targets met**



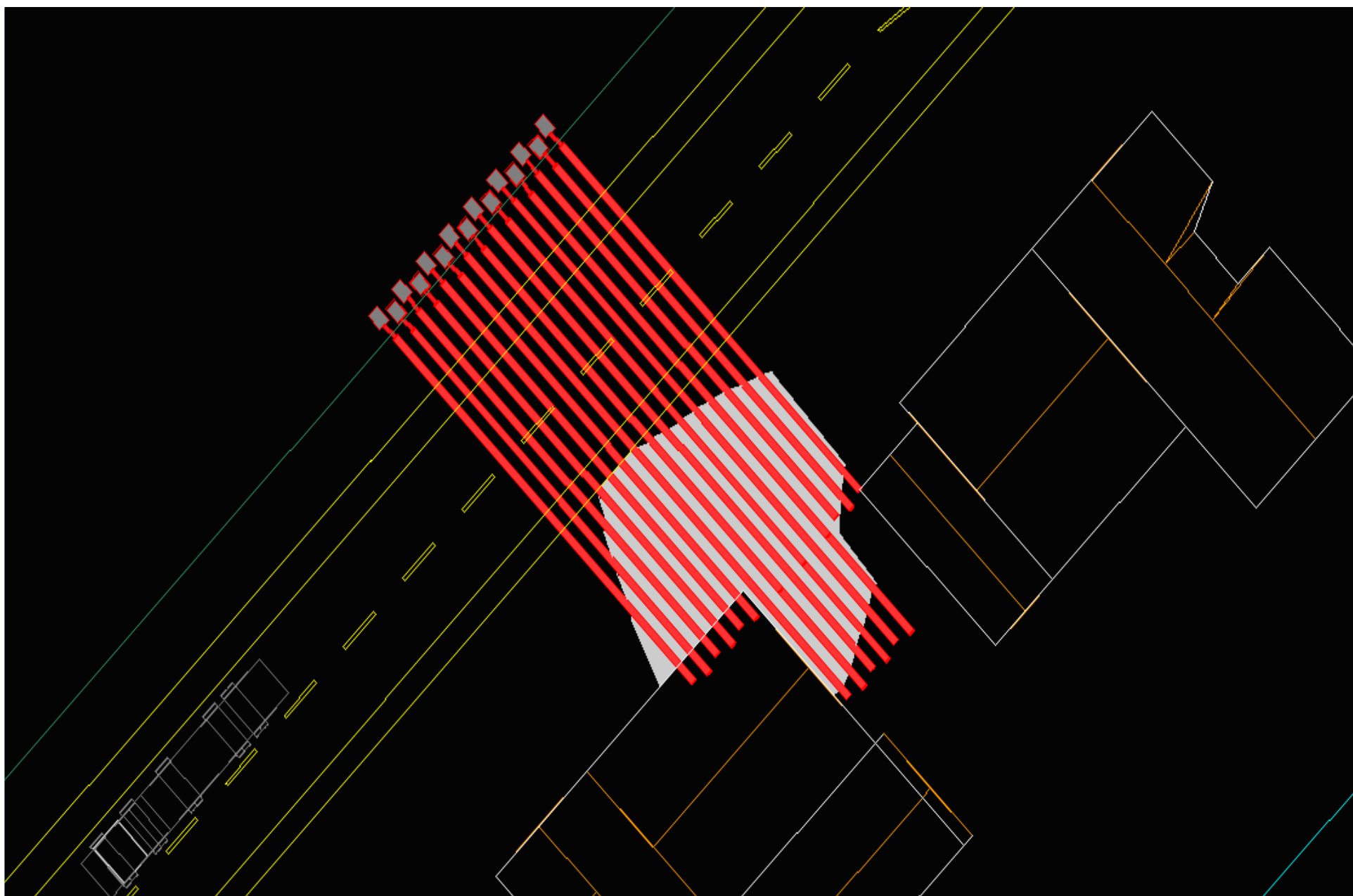
Costs

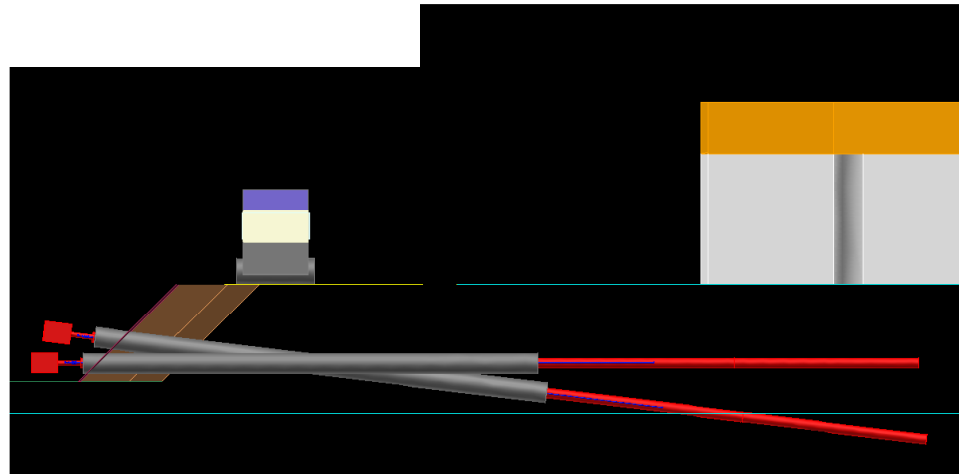
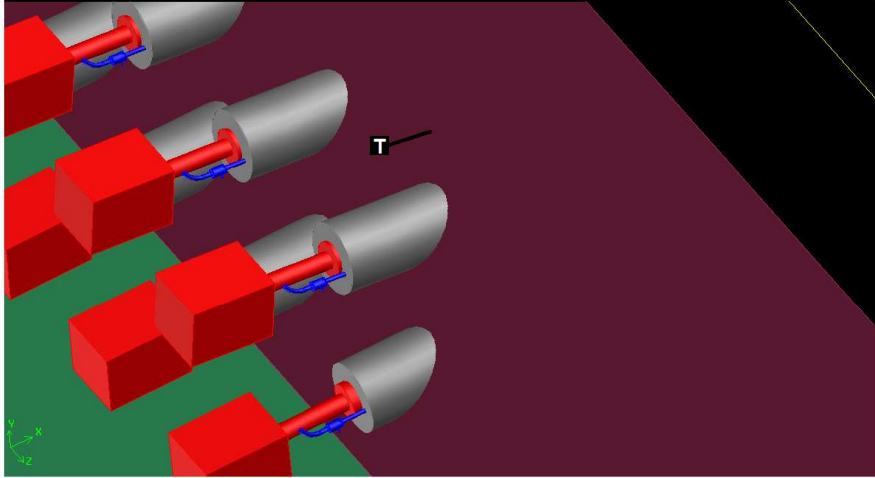


Various applications

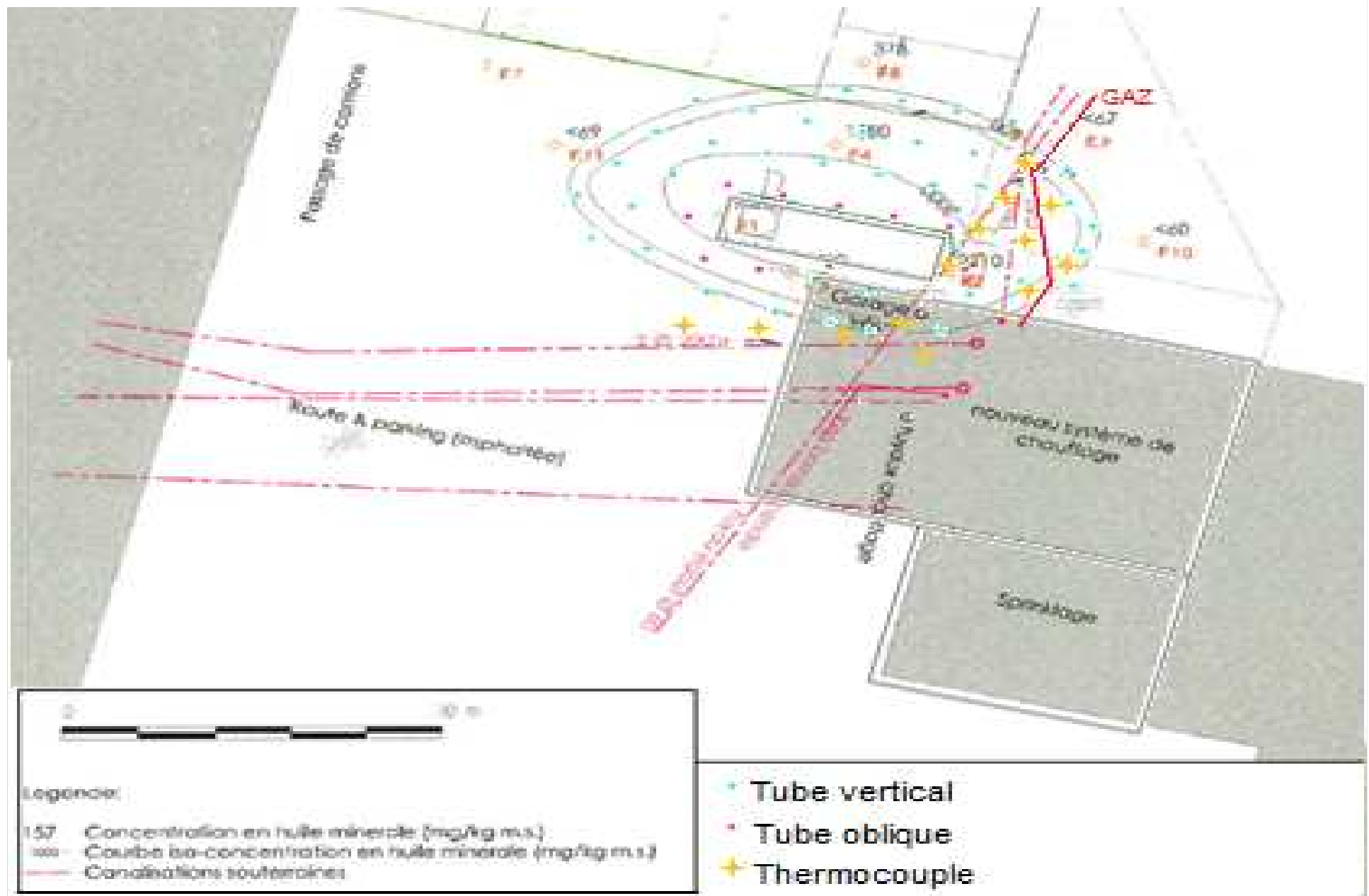


Abdijstraat

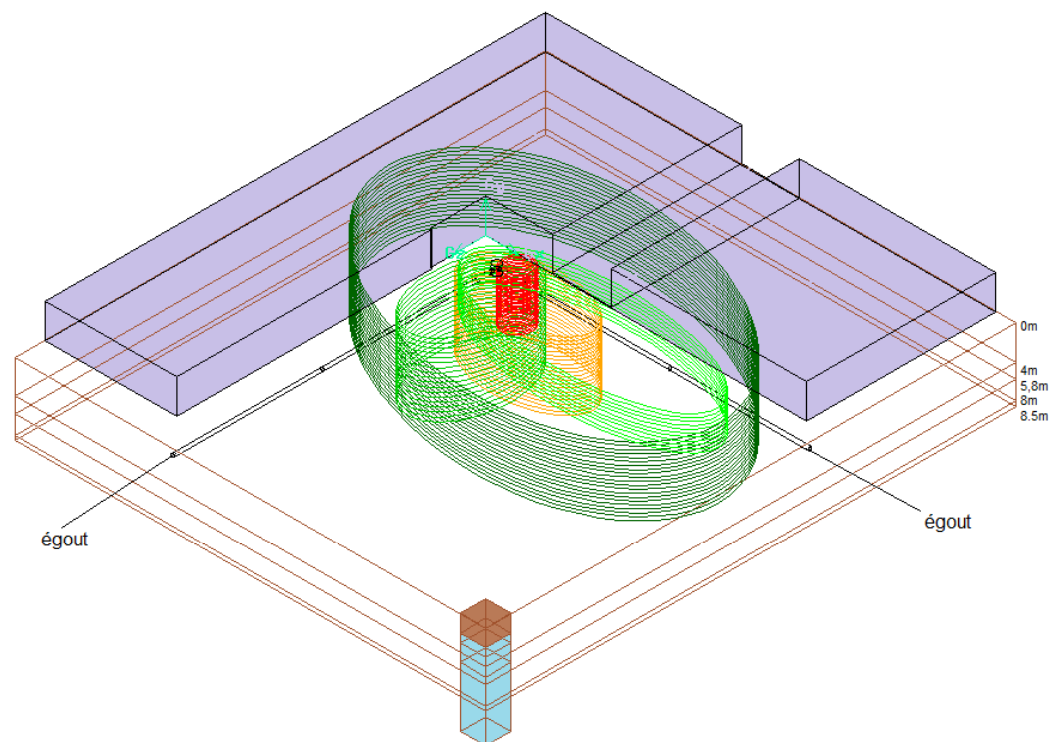




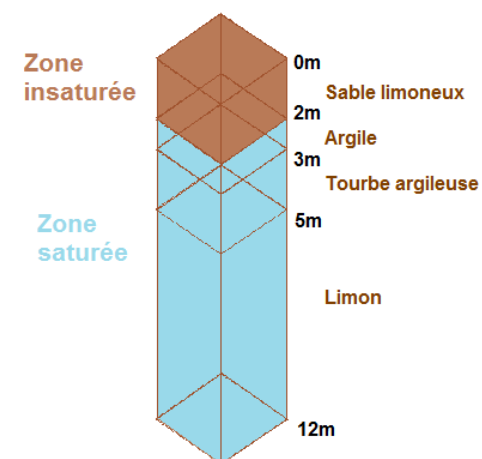
Underground piping?



Shopping Mall



Composition du sol



Contamination

Zone insaturée

> NI (max. 58mg/kg ms en tétrachloroéthène et max. 180 mg/ kg ms en huiles minérales (C8-C10))

5.8m

> NA (max. 180 mg/kg ms en tétrachloroéthène)

8,5m

Zone saturée

>NI (max. 120000µg/l en tétrachloroéthène et max. 2500 µg/l en huiles minérales (C8-C10))

8m

> NA (max. 57 µg/l en tétrachloroéthène)

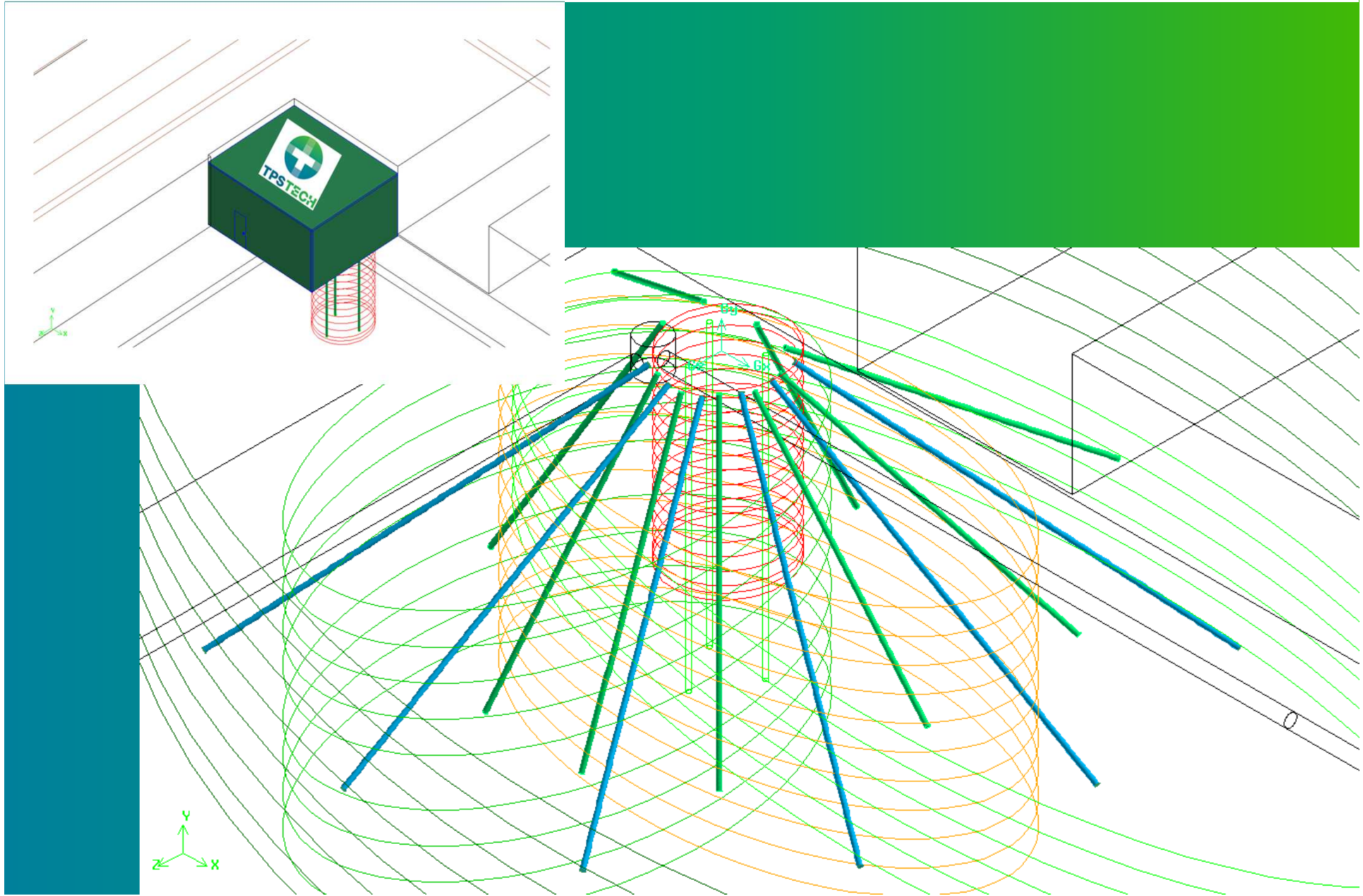
4m

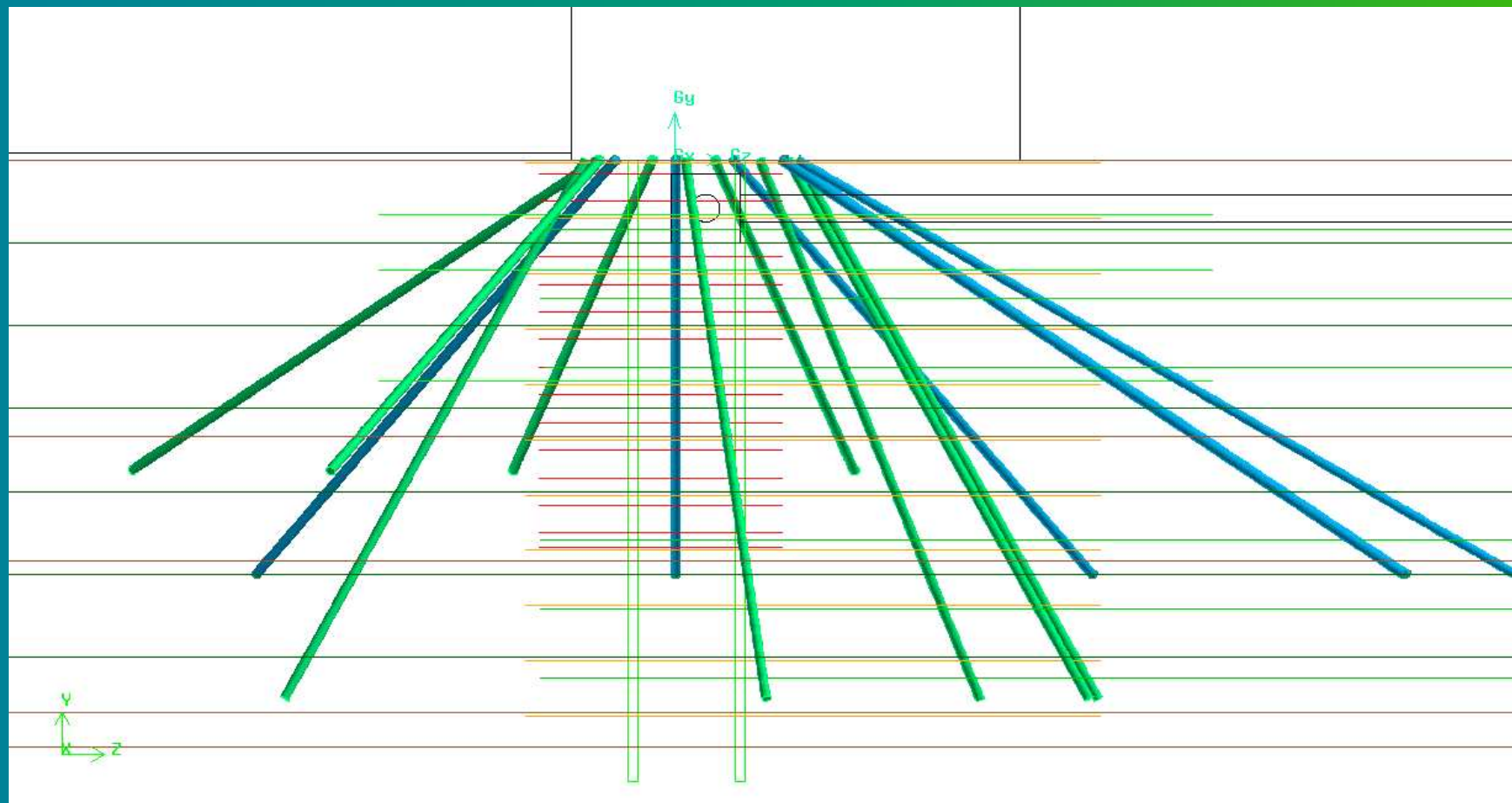
> NA (max. 27 µg/l en tétrachloroéthène)

8m

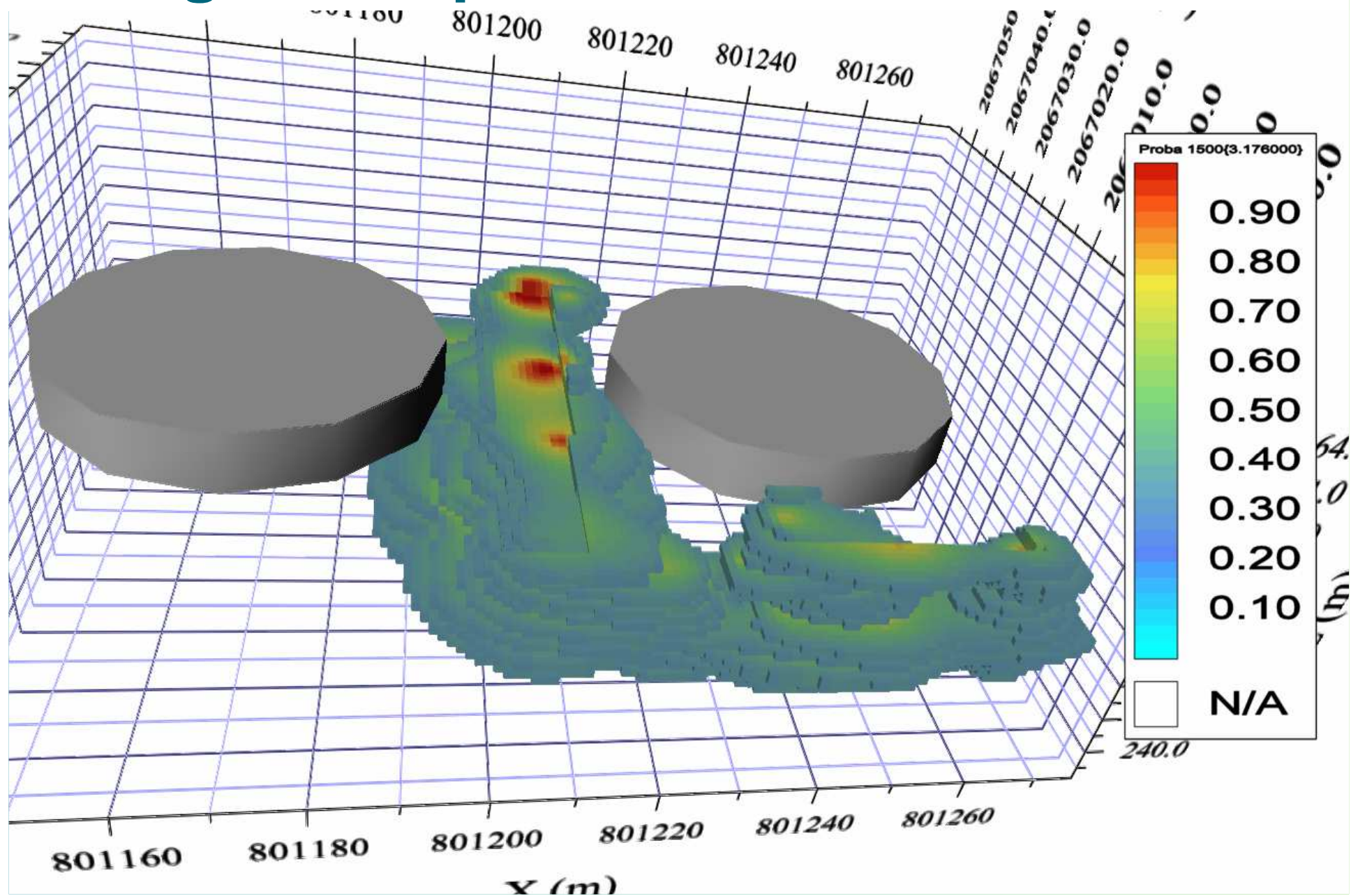
Normes pour le tétrachloroéthène

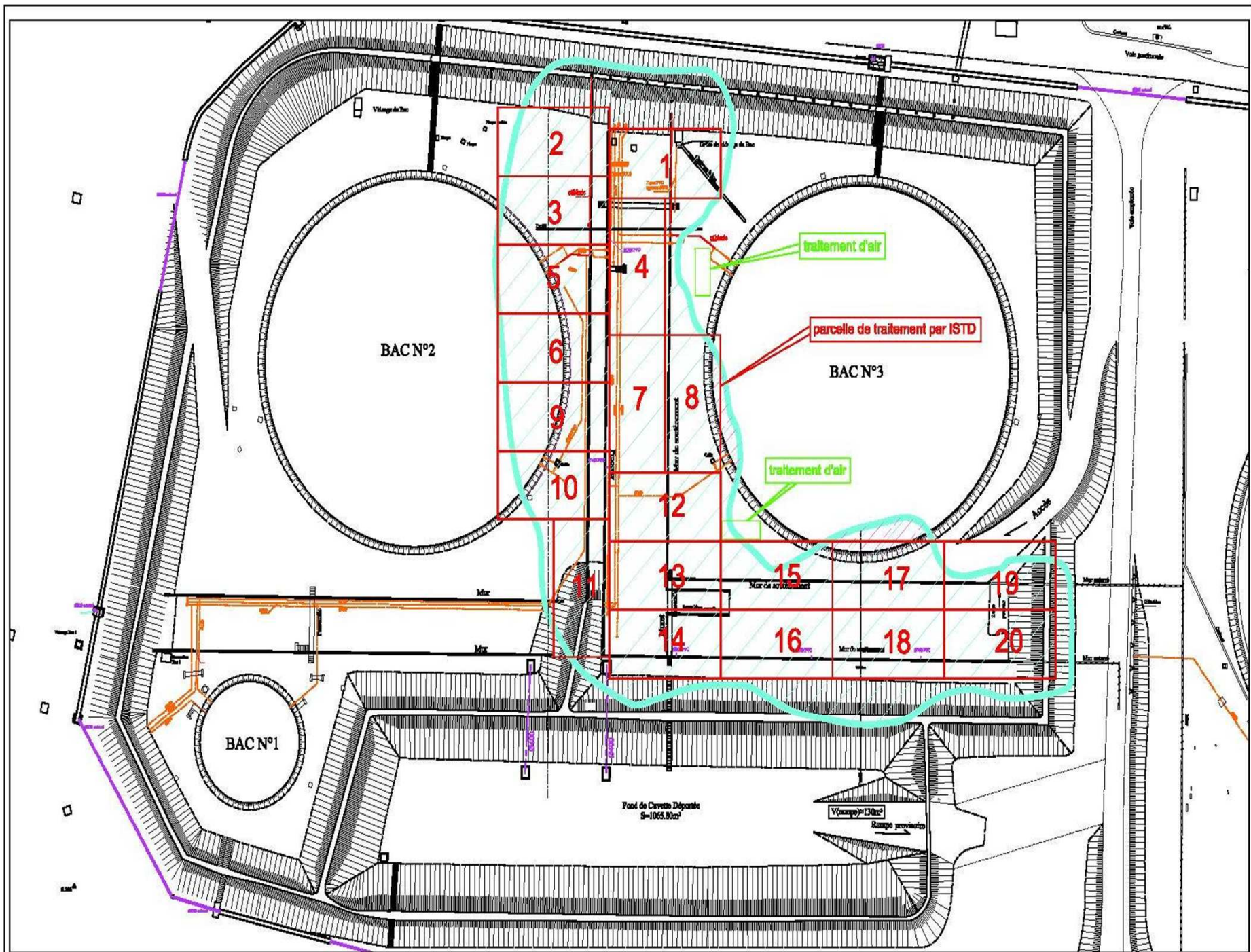
	NI	NA
Zone insaturée	1,4 mg/ kg ms	0,28 mg/kg ms
Zone saturée	40µg/l	5 µg /l



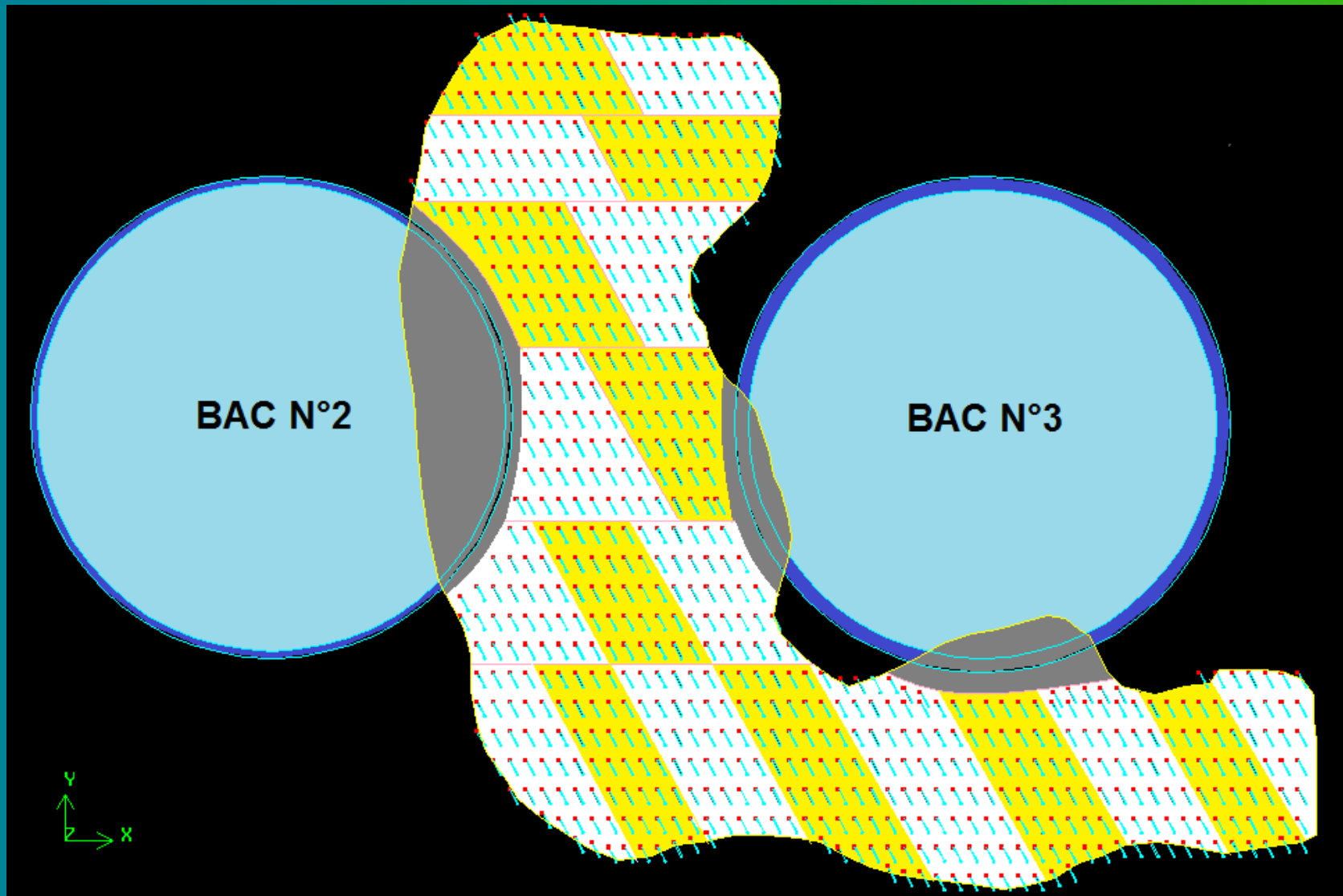


Large oil depot

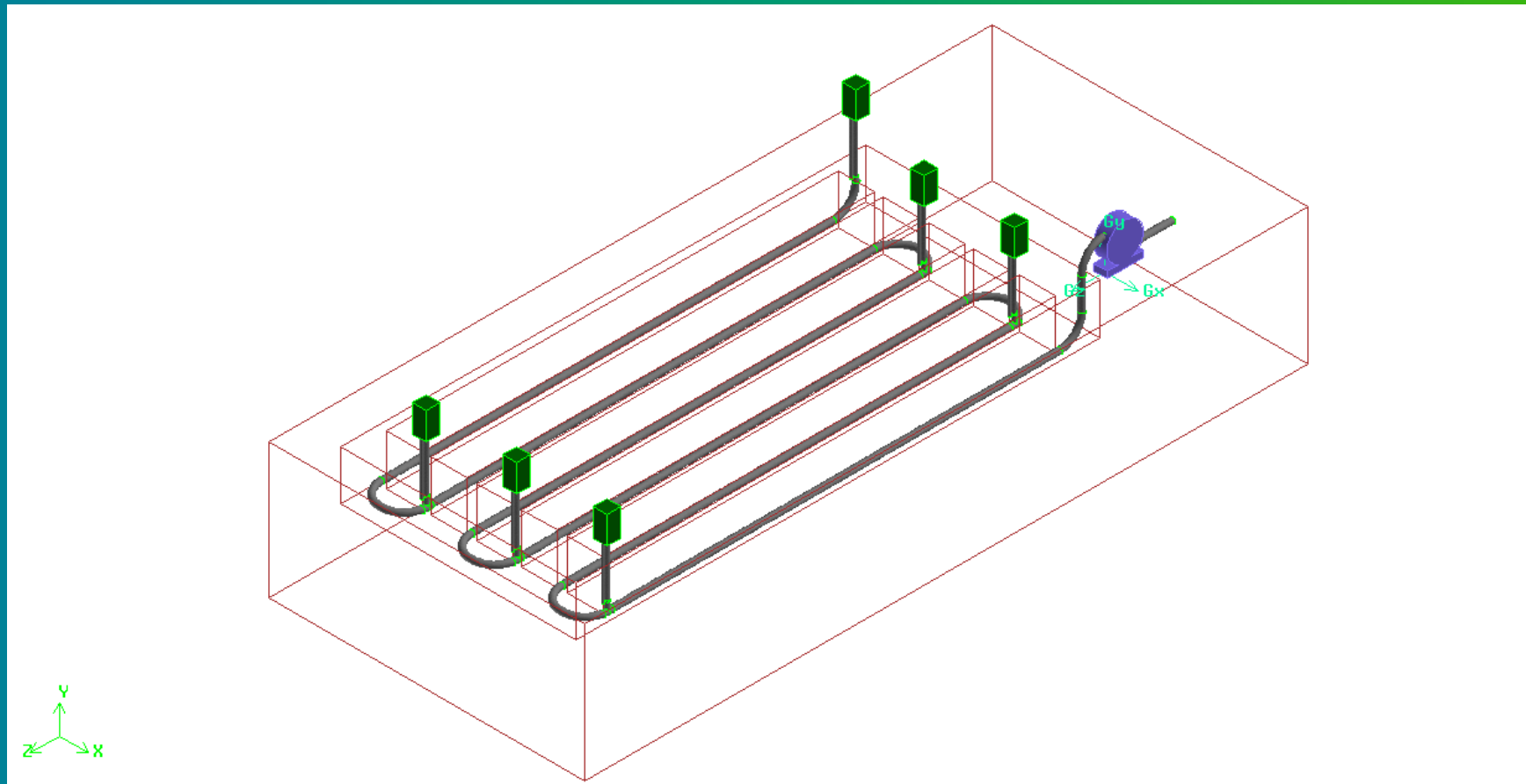




Large oil depot



Shallow contamination (garden)



Price ranges

CITY					
Surface	Av. Depth	Tons	Pollutant	Difficulty?	Price
62 m ²	4 m	409 tons	TPH	no	33,500
23 m ²	14 m	531 tons	TPH	no	69,500
57 m ²	6 m	564 tons	PAH + TPH	under building	267,500
24 m ²	13 m	515 tons	TPH	under building	214,500
3551 m ²	9 m	57,526 tons	TPH	no	2,900,000
1263 m ²	9 m	20,460 tons	TPH	ATEX zone	1,740,250
80 m ²	12 m	1584 tons	TPH	Floating layer	213,500
125 m ²	7 m	1444 tons	TPH	high humidity	182,500
60 m ²	5 m	495 tons	VOCI	no	44,000
28 m ²	4 m	185 tons	VOCI	under building	16,500
36 m ²	2 m	130 tons	PAH	no	14,500
45 m ²	6 m	446 tons	PAH	under building	42,500
73 m ²	4 m	482 tons	Mercury	no	155,500



we restore the value of your property

search

share me



@TPSTECH - 2 followers

+ home

get a quote

experts

owners

references

news

about TPS

contact



WE CARE! DO YOU?

TPS Tech restores your property value

Research & Development of thermal soil remediation technologies is the core activity of TPS Tech. As engineers, we love technology, but our aim is beyond: we care! We understand you want the best value for your money and this is why we offer both competitive prices and the guarantee that your property will get its full value back.

Environmental efficiency is the other priority at TPS tech. We reduce environmental footprint to the minimum. Our extra services such as geothermy or stability preparation are a good example of our global concern. We also care about people: about you, customers, engineers, partners, as well as your neighbours.

TPS at Milieu2011

04/10/2011

With our Dutch partner A&G Milieutechniek we will have a booth at Milieu2011, Den Bosch, 4-6. On Oct 5 at 12.00 h Marten Kingmans will present the NSR technology.

[learn more](#)

Real estate conference - October 5th

04/10/2011

You are a real estate specialist in Brussels? Don't miss our conference on October 5th. We will present our brand new NSR City© technology, developed especially to treat urban soil pollution.

[learn more](#)

New partnership agreement

02/10/2011

TPS has signed a partnership agreement with A&G Milieutechniek bv, a company of the Van Gansewinkel Groep, to operate the NSR technology in: the Netherlands (joint venture), Czech republic (joint venture), Poland (TBD).

BREAKING NEWS

NSR City© The only efficient urban soil remediation solution

TPS Tech invented NSR City to offer problem owners and project developers a solution to their main concern regarding soil contamination: 1° guaranteed restoration of their full property value ; 2° speed and discretion. With NSR City, no soil excavation, no transportation, extreme modularity, so that even the most inaccessible places (basements) are no longer a problem for complete remediation.

Wants to read more about the technique? [Read more](#)

Searching a solution for your ground? [Read more](#)

GET A QUOTE NOW !

faq's

Is it possible to treat below the watertable?

When rising the temperature, the viscosity of the contaminant decreases, making it more moveable in the soil. Combining NSR© with...

[read more](#)

What is the maximum area/volume treatable?

There is no limit of area or volume with NSR© treatment. The